STEVENS INSTITUTE OF TECHNOLOGY

CASTLE POINT STATION
HOBOKEN, NEW JERSEY 07030



1

TR-2566

# DAVIDSON LABORATORY

Technical Report SIT-DL-87-9-2566
September 1987

# PRESSURE DISTRIBUTIONS AND LOSSES IN A WATERJET PROPULSION SYSTEM

by
Martin N. Burtness

Prepared for

Office of Naval Research

under

Contract N00014-83-C-0780
(Davidson Laboratory Project 5267/190)

TR-2566

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

# REPORT DOCUMENTATION PAGE

| | |
|---|---|
| 1a. REPORT SECURITY CLASSIFICATION<br>Unclassified | 1b. RESTRICTIVE MARKINGS A188423 |
| 2a. SECURITY CLASSIFICATION AUTHORITY | 3 DISTRIBUTION/AVAILABILITY OF REPORT<br>APPROVED FOR PUBLIC RELEASE;<br>DISTRIBUTION UNLIMITED |
| 2b. DECLASSIFICATION/DOWNGRADING SCHEDULE | |
| 4. PERFORMING ORGANIZATION REPORT NUMBER(S)<br>SIT-DL-87-9-2566 | 5. MONITORING ORGANIZATION REPORT NUMBER(S) |
| 6a. NAME OF PERFORMING ORGANIZATION<br>Stevens Inst. of Technology<br>DAVIDSON LABORATORY — 6b OFFICE SYMBOL (If applicable) | 7a. NAME OF MONITORING ORGANIZATION |
| 6c. ADDRESS (City, State, and ZIP Code)<br>Castle Point Station<br>Hoboken, New Jersey 07030 | 7b. ADDRESS (City, State, and ZIP Code) |
| 8a. NAME OF FUNDING/SPONSORING ORGANIZATION<br>Office of Naval Research — 8b OFFICE SYMBOL (If applicable) | 9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER |
| 8c. ADDRESS (City, State, and ZIP Code)<br>800 North Quincy Street<br>Arlington, Virginia 22217 | 10 SOURCE OF FUNDING NUMBERS<br>PROGRAM ELEMENT NO. / PROJECT NO / TASK NO. / WORK UNIT ACCESSION NO |

11 TITLE (Include Security Classification)

Pressure Distributions and Losses in a Waterjet Propulsion System

12 PERSONAL AUTHOR(S)

Martin N. Burtness

| 13a. TYPE OF REPORT | 13b TIME COVERED | 14 DATE OF REPORT (Year, Month, Day) | 15 PAGE COUNT |
|---|---|---|---|
| Final | FROM 9/15/83 TO 9/14/86 | September 1987 | |

16 SUPPLEMENTARY NOTATION

| 17 COSATI CODES | | | 18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number) |
|---|---|---|---|
| FIELD | GROUP | SUB-GROUP | Waterjet<br>Pressure Distribution |

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

A simplified model of a waterjet was designed and built at Davidson Laboratory, Stevens Institute of Technology to evaluate the performance of several waterjet configurations suitable for installation on a high water speed amphibian landing craft. The objective of this experimental study was to investigate alternative combinations of inlet length and transition length and to use these data to design an optimum waterjet system with minimum losses. A 1:5.367 scale model having four interchangeable inlets and three transition sections was used and model tests were conducted to determine the flow rates, pressure distributions, and losses existing in the waterjet.

| 20 DISTRIBUTION/AVAILABILITY OF ABSTRACT | 21 ABSTRACT SECURITY CLASSIFICATION | |
|---|---|---|
| ☐ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS | | |
| 22a NAME OF RESPONSIBLE INDIVIDUAL | 22b TELEPHONE (Include Area Code) | 22c. OFFICE SYMBOL |

DD FORM 1473, 84 MAR — 83 APR edition may be used until exhausted. All other editions are obsolete

SECURITY CLASSIFICATION OF THIS PAGE

UNCLASSIFIED

**STEVENS INSTITUTE OF TECHNOLOGY**
**DAVIDSON LABORATORY**
**Castle Point Station, Hoboken, New Jersey 07030**

Technical Report SIT-DL-87-9-2566

September 1987

# PRESSURE DISTRIBUTIONS AND LOSSES IN A WATERJET PROPULSION SYSTEM

by

Martin N. Burtness

| Accession For | |
|---|---|
| NTIS GRA&I | ☑ |
| DTIC TAB | ☐ |
| Unannounced | ☐ |
| Justification | |
| By | |
| Distribution/ | |
| Availability Codes | |
| Dist | Avail and/or Special |
| A-1 | |

Prepared for

Office of Naval Research

under

Contract N00014-83-C-0780
(Davidson Laboratory Project 5267/190)



APPROVED: Daniel Savitsky
Director

TABLE OF CONTENTS

# NOMENCLATURE

| | |
|---|---|
| $A_i$ | Jet inlet area, sq ft |
| $A_p$ | Jet area at impeller, sq ft |
| $A_T$ | Jet test section area, sq ft |
| $C_{Di}$ | Inlet drag coefficient, $D_i/(0.5\rho w\ l\ V_o^2)$ |
| $C_{Li}$ | Inlet lift coefficient, $L_i/(0.5\rho w\ l\ V_o^2)$ |
| D | Model drag, lb |
| $D_h$ | Hull drag, lb |
| $D_i$ | Inlet drag, lb, $D - D_h - D_m$ |
| $D_m$ | Momentum drag, lb, $\rho Q V_o$ |
| $D_p$ | Impeller diameter, ft |
| g | Acceleration of gravity, 32.174 $ft^2/sec$ |
| $H_{atm}$ | Atmospheric pressure head, 33.08 ft |
| $H_p$ | Pressure head induced by the impeller, ft |
| $H_{vap}$ | Vapor pressure of water, 1.0 ft |
| IVR | Inlet velocity ratio, $V_I/V_o$ |
| $K_{ot}$ | Inlet loss coefficient, $(V_o^2/2g - P_{T\ tot})/(V_T^2/2g)$ |
| l | Inlet length, ft |
| L | Model lift, lb |
| $L_h$ | Hull lift, lb |
| $L_i$ | Inlet lift, lb, $L - L_h$ |
| $P_{T\ stat}$ | Static pressure head at test section, ft |
| $P_{T\ tot}$ | Total pressure head at test section, ft |
| Q | Mass flow rate through jet, cfs |
| RPR | Ram pressure recovery $(P_{T\ tot})/(V_o^2/2g)$ |
| TVR | Test section velocity ratio, $V_T/V_o$ |
| $V_I$ | Inlet velocity, fps, $Q/A_i$ |
| $V_o$ | Freestream velocity, fps |
| $V_T$ | Test section velocity, fps, $Q/A_T$ |
| w | Inlet width, ft |
| $\rho$ | Mass density of water, $lb\text{-}sec^2/ft^4$ |
| $\sigma$ | Cavitation Index, $(H_{atm} + P_{T\ stat} - H_{vap})/(V_T^2/2g)$ |

## INTRODUCTION

A simplified model of a waterjet was designed and built at Davidson Laboratory, Stevens Institute of Technology to evaluate the performance of several waterjet configurations suitable for installation on a high water speed amphibian landing craft. The objective of this experimental study was to investigate alternative combinations of inlet length and transition length and to use these data to design an optimum waterjet system with minimum losses. A 1:5.367 scale model having four interchangeable inlets and three transition sections was used and model tests were conducted to determine the flow rates, pressure distributions, and losses existing in the waterjet. Tests were conducted in the Davidson Laboratory Tank 3 facility in October and November of 1986. Portions of the testing were witnessed by Mr. John Hoyt, Code 1562, DWTNSRDC. All preliminary test results were previously submitted to Code 1562 and have been used in a design of a full scale waterjet. The study was funded by Code 12 of DWTNSRDC and administrated under Office of Naval Research Contract N00014-83-C-0780.

## MODEL

The test model was designed to simulate a waterjet installation in a proposed high water speed amphibian vehicle being developed by Code 12 of DWTNSRDC. The amphibian is designed with a large fully retractable transom flap to increase the vehicle length when water-borne and to decrease the trim in the hump speed region. The size of the flap is such that the waterjet system can be completely installed within its geometry. When the flap is fully retracted for land operation, the waterjet system is rotated to a vertical position at the transom.

The purpose of this model study was to provide data on the pressures, velocities, and losses through the intake and transition region up to the impeller. These data would then be used to design the full scale waterjet. The model test impeller and drive motor were selected to provide the required flow quantities through the inlet and transition sections of the waterjet. No attempt was made to represent the full scale impeller. Figure

1 shows a sketch of the model and test apparatus. The scale of this model was 1:5.367 and was selected based on using a stock propeller existing at the Davidson Laboratory, which corresponded to the projected diameter of the full scale impeller. Detailed characteristics of the model are given in Table 1. The model hull was constructed in two parts, forward and aft of the hinge point. The forward section was constructed of clear acrylic plastic and represents the bottom of the amphibian. The aft section of the model was constructed of PVC and represents the retractable transom flap which houses the waterjet system. Both sections had zero degree deadrise with the aft section inclined downward 4 degrees relative to the forward section. This corresponds to the optimum flap setting determined by model tests of the bare hull at DWTNSRDC. These tests also showed that the optimum running trim of the forebody was at 10 degrees with the resulting trim of the transom flap at 14 degrees. These conditions were set in the model for all test runs.

The waterjet was composed of six separate sections as shown in Figure 2: the inlet, with static pressure taps I2, I3 and I4 in the wall; the transition section with static pressure taps T1, T2 and T3 in the wall; the circular test section with 6 Prandtl tubes in the flow; the diffuser; the impeller section with two static pressure taps H1 and H2 ahead and astern of the impeller; and the exit ducting. The test model was constructed so that various combinations of inlet and transition sections could easily be installed.

Inlets: The baseline inlet design was the so-called Stevens inlet which had previously been used in a manned-model test craft during the initial stages of the waterjet development program (References 1, 2 and 3). This was the longest of the four inlets tested and is shown in Figure 3. This inlet has a maximum cross-section width of 16.1 inches.

In an attempt to develop shorter inlets which could be more readily installed in the fixed length transom flap, DWTNSRDC developed three additional, but shorter inlets which are shown in Figures 4, 5, and 6. These inlets are 21.25" wide. In addition to being shorter than the Stevens inlet, the leading edge of each DWTNSRDC inlet rises above the trailing edge. These three inlets are identified as the 21/2.50, 27/0, and 21/0 inlets, where the first number refers to the full scale length of the inlet and the second number refers to the rise of the leading edge above the

tangent to the upper surface of the aft lip of the inlet. Eighty grit sandpaper was attached to this lip to provide turbulence stimulation to the flow entering the inlet.

Transition: Three interchangeable transition sections were molded from PVC and were mounted in an aluminum frame. The transition sections transferred the flow from the square section of the inlet to the round section of the impeller. These transitions modeled 6, 8, and 10 inch full-scale transition lengths.

Test Section: The test section was located immediately after the transitions. This section contained a row of Prandtl tubes to measure the velocity profile at the location of the prototype impeller. Ports were located in the test section to allow the Prandtl tubes to be set at three angular positions as seen in Figure 7.

Diffuser: The diffuser section transferred the flow from a 3 inch to a 4 inch diameter duct where the test impeller was located. This impeller was housed in a brass section carrying the shaft bearing on a cruciform strut.

Exit Ducting: Aft of the diffuser and impeller duct is the exit ducting. This ducting div· ·ed the flow out the sides of the test craft so that the waterjet would not impart any thrust to the model, allowing the hydrodynamic drag to be measured directly.

## INSTRUMENTATION

Forces: Model lift and drag were measured using a multi-component balance fitted with linear-variable, differential transformers. The capacity of the balance allowed for measurements of up to 500 lb drag and 1000 lb lift.

Shaft Speed: The model impeller was belt driven by a 5 hp motor. The differential diameters between the motor and impeller shafts provided a 1.75 ratio impeller speed increase to allow for testing at up to 5100 rpm. The motor control box contained a frequency to voltage converter, which provided a voltage proportional to motor speed. This voltage was calibrated against the motor rpm using a strobe light.

Pressure Measurements: Pressure taps were connected to diaphragm-type, differential pressure gages (Schaevitz Pressure Transducer Model P-3091) with water-filled flexible tubing. Since zero values for all data channels were taken with the model at rest in the water, the pressure-transducer zeros represent a head of water equal to the submergence of each pressure tap. This head was calculated within the data processing program based on the model attitude and the location of each pressure tap. The static head for each tap with the model at 14 deg trim and 11 inch draft can be found as follows:

$$\text{head,ft} = 11/12 - [X * \sin(14\ \text{deg}) + Z * \cos(14\ \text{deg})]/12$$

Table 2 gives the horizontal distance (X) forward of the transom and the vertical distance (Z) above the baseline, in inches, for each pressure tap location.

## PHOTOGRAPHY

All test runs were recorded on a VHS videocassette. The camera was set up to show a bow-quartering view. Above water photographs of the model and apparatus appear in Figures 8 and 9.

## TEST PROCEDURE

### Jet Velocity Calibration

The jet velocity was determined from a velocity survey of the test section and calibration of the bollard pull velocities. The velocities were measured with a rake of 6 Prandtl tubes inserted into the test section at three angular orientations: in the vertical plane (0 degrees), at 45 degrees and in the horizontal plane (90 degrees) so that pressure readings were obtained at 18 radial and angular locations within the test section as is shown in Figure 7. The flow was assumed to be symmetric about the centerplane so the pressures measured at 45 degrees were mirrored to the opposite side. These pressures were integrated over the test section to

determine an average pressure and thereby an average integrated velocity through the waterjet. The integration method employed in determining the average pressure in the section assumed that the pressures were constant in each radial segment of the annulus as follows:

$$P_{avg} = [\ (P3+P4)/2*(.6875^2-.2325^2) + (P2+P5)/2*(1.0625^2-.6875^2) + (P1+P6)/2*(1.5000^2-1.0625^2)\ ] / (1.5000^2-.2325^2)$$

This calculated flow was then compared to the actual flow measured through the waterjet. To obtain a direct measurement of the flow, a PVC pipe was attached to each waterjet exit to redirect the flow into the docking basin. The actual mass flow rate through the jet was measured by recording the time required to fill the docking basin. Figure 10 shows the calculated flow rates and the measured flow rates plotted against the impeller rpm. These data are tabulated in Appendix A along with the pressure distributions used to develop the integrated flow rates. From these data the relationship between actual and integrated flow rates was determined to be:

Actual flow rate = Integrated average flow rate - 0.04 cfs

The close agreement between measured and computed flow rates indicates that the method chosen to integrate the pressure distribution within the test section is valid. This relationship was applied to each test condition to determine the flow rates presented in this report. The flow rates for each inlet/transition combination and nominal impeller rpm are summarized in Table 3. While running the model tests, the impeller rpm could not be precisely controlled but was within ± 50 rpm of the set value. No attempt was made to correct for this rpm variation between runs. Results are tabulated in terms of the nominal rpm. The inlet velocity ratio (IVR) and test section velocity (TVR) determined from these flow rates are given in Table 4. The velocity ratios are defined as the velocities in the inlet or test section as a fraction of the free stream velocity; i.e. IVR = $V_I/V_O$ and TVR = $V_T/V_O$.

## Bollard Pull

Bollard pull tests were conducted in the docking basin to determine the model lift and drag forces and pressure distributions in the waterjet ducting at zero model speed. A semi-circular, U-shaped fairing was fitted around the sides and aft end of the inlet during the bollard pull tests to smooth the flow entering into the duct and prevent flow separation along the bottom of the inlet. Once steady-state conditions were established at the desired impeller rpm, the data were averaged over a 10 second period.

Before testing at each configuration, a clear plexiglass box was placed in the exit stream to determine the degree of aeration in the flow by observing the passage of air bubbles. A small degree of aeration in the flow was present but was judged to have a minimal effect on the model data.

## Ahead Speed

The test craft was towed at a constant speed of 26.5 fps. This is the same speed at which the prototype vessel will operate. Since the model waterjet impeller will be experiencing the same velocity as is present in the full scale, no expansion of the data was required. It must be noted that the lift and drag data presented in this report apply to the model test craft and not to the prototype vessel. The model was fixed in surge, sway, heave, roll, pitch and yaw. The trim of the baseline was set at 14 degrees corresponding to the full scale craft running at 10 degrees with the transom flap deflected 4 degrees. The model heave was adjusted to a transom draft of 11 inches. This draft allowed unaerated flow to enter the inlet while keeping much of the forward section of the hull out of the water.

Model force and pressure distribution data were taken and averaged over a 50 foot length of model travel after the test craft had accelerated to steady speed. Approximately 10 minutes were allowed to pass between successive runs to allow a surface skimmer to quiet the tank surface.

Three runs were made at each test condition to allow for an angular survey of the pressures in the test section. Therefore, three sets of inlet pressures, transition pressures, model lift, and model drag data were taken.

To determine the effect of the inlet alone on the vessel lift and drag, tests were run with the inlet covered by a flat plate at the design speed of 26.5 fps. These readings were compared with the test runs with the pump operating to determine the effect of inlet flow on the lift and drag.

### Boundary Layer

Tests were conducted to determine the depth of the boundary layer ahead of the inlet. A Prandtl tube located in front of the inlet was used to determine the water velocity at varying depth from the hull at the design speed, with and without the impeller running.

## TEST PROGRAM

Tests were conducted in Davidson Laboratory Tank 3, 313 ft x 12 ft x 5.4 ft deep. Each inlet and transition combination was tested at three impeller rpm's for both bollard pull (0 fps) and design speed (26.5 fps) to cover the range of inlet velocity ratios expected for the prototype vessel. To complete the velocity survey, three runs were made at each condition, with the Prandtl tubes in the test section set at 0 deg (top), 45 deg (diagnal) and 90 deg (side). The following combinations were tested:

### Basic Test Program

| Inlet | Transition length, in | Model Speed fps | Nominal Impeller rpm |
|---|---|---|---|
| Stevens | 8 | 0 | 2200, 2800, 3600 |
| | | 26.5 | 3600, 4300, 5100 |
| 21/2.50 | 6, 8, 10 | 0 | 2800, 3600, 4300 |
| | | 26.5 | 3600, 4300, 5100 |
| 27/0 | 6, 10 | 0 | 2800, 3600, 4300 |
| | | 26.5 | 3600, 4300, 5100 |
| 21/0 | 6,10 | 0 | 2800, 3600, 4300 |
| | | 26.5 | 3600, 4300, 5100 |

### Boundary Layer Tests

Boundary layer tests were conducted at the following conditions, with the Prandtl tube located 4-1/2 inches ahead of the inlet and 9 inches aft of the calm water surface intersection with the hull.

THIS

PAGE

IS

MISSING

IN

ORIGINAL

DOCUMENT

8

Similarly, the change in lift induced by the inlet was determined by subtracting the bare hull lift, $L_h$, from the measured lift.

$$L_i = L - L_h$$

where $L_i$ = inlet lift

$L$ = measured lift (with pump operating)

$L_h$ = bare hull lift

Both the inlet lift and inlet drag results were non-dimensionalized by the inlet width, length and free stream velocity to develop the coefficients given in the tables and plotted in Figures 11 and 12. These figures show average coefficient values for every group of three runs at the same condition. Several runs contain spurious data. In these cases, the drag and lift coefficients plotted are the average of the two good runs at that condition. The 21/2.50 inlet shows the greatest reduction in drag while the Stevens inlet shows a slight increase in drag at the lower velocity ratios (Figure 11). The model inlet drag for all the inlets varied from about 10 to -10 lbs. All the inlets exhibited very similar performance with regard to decrease in lift. The lift coefficients varied from about -0.5 at an IVR of 0.95 to -0.8 at an IVR of 1.2.

The relative performance of the waterjet configurations may be evaluated on the basis of two key coefficients; $K_{ot}$ and RPR.

$K_{ot}$ is a loss coefficient related to the pressure drop occurring in the inlet and transition sections and is defined as follows:

$$K_{ot} = (V_o^2/2g - (P_{T\ tot}) / (V_T^2/2g)$$

A low loss coefficient indicates high efficiency. These coefficients are tabulated in Table 8 and are plotted versus the test section velocity ratio in Figure 13 for each inlet and transition length. The Stevens inlet shows the lowest loss coefficient of 0.19 at the design TVR of 1.4. The 27/0 inlet is next best with loss coefficients of about 0.25. The 21/2.50 inlet has loss coefficients varying from between 0.27 and 0.30 for the three transition lengths of 6, 10 and 8 inches. The 21/0 inlet shows the worst performance by far having loss coefficients of 0.37 and 0.40 at the design TVR for the 6 and 10 inch transition lengths respectively.

RPR is the ram pressure recovery at the test section. A RPR of 1.00 indicates that all the energy available in the free stream flow has been recovered and is available to do work; this coefficient is a measure of the inlet and transition efficiency and is defined as:

$$RPR = (P_{T\ tot})/(V_o^2/2g)$$

A summary of the coefficient is given in Table 9. These coefficients are plotted against the test section velocity ratio in Figure 14. This figure shows that the Stevens inlet has the highest recovery ratio of 0.62 while the 21/0 inlet has the lowest of about 0.25 at the design test section velocity ratio of 1.40. The 27/0 inlet has a RPR of 0.52 with transition length having little effect on the inlet performance. The 21/2.50 inlet has recovery ratios of 0.42 to 0.47 at the design TVR.

An additional parameter that is of interest in evaluating these inlets is the cavitation index, $\sigma$, in the test section where the prototype impeller will be located.

$$\sigma = (H_{atm} + P_{T\ stat} - H_{vap})/(V_T^2/2g)$$

When this index falls below a critical value, cavitation will occur. $\sigma$ is tabulated in Table 10 and plotted in Figure 15 as a function of the test section velocity ratio. These results show that the Stevens inlet is least likely to cavitate with $\sigma = 0.78$ and the 21/0 inlet is most susceptible to cavitation with $\sigma = 0.54$ at the design TVR of 1.40.

## BOUNDARY LAYER RESULTS AND DISCUSSION

Results of the boundary layer study ahead of the inlet are given in Table 11. These results give the velocity profile at varying distance from the hull bottom for two inlet velocity ratios; IVR = 0 and IVR = 1.16. The velocity distribution is shown in Figure 16. As expected, with an IVR of 1.16, a positive pressure gradient in the flow develops and the local measured velocity exceeds the free stream velocity (u/U > 1.0). With zero pressure gradient in the flow (IVR = 0), the boundary layer thickness, defined as u/U = 0.99, is 0.265 inches, model scale.

## CONCLUSIONS

The Stevens inlet with an 8 inch transition section showed the best overall performance. This good performance can be attributed to its relatively long inlet length compared to the other inlets tested. The Stevens inlet had the highest ram pressure recovery ratio, lowest loss coefficient and was the least susceptible to cavitation of all the inlets. However, it did suffer a slight increase in drag at the lower inlet velocity ratios.

The 27/0 inlet had the lowest losses and highest recovery ratio of the three DWTNSRDC inlets. The 21/2.50 inlet showed the greatest reduction in drag of all the inlets and better performance than the 21/0 inlet.

The inlet length is of primary importance in the efficiency of the waterjet configuration. The 27/0 inlet showed an increase in efficiency of approximately 52 percent over the 21/0 inlet. Inlet rise is also very important, shown by the 35 percent improvement in performance of the 21/2.50 inlet over the 21/0 inlet. The length of transition does not seem to significantly effect the inlet efficiency, lift and drag characteristics or likelihood of cavitation.

## ACKNOWLEDGEMENT

I wish to thank Mr. Aldo Sori, Chief Designer at the Davidson Laboratory for his invaluable work in designing the waterjet model and his continued assistance throughout the completion of this project. Mr. John K. Roper of Roper Associates provided the major effort in developing the Stevens waterjet concept and assisted in the analysis of the test data. The support of our machinists Marshall Reid and Doug Meding, and our laboratory technician John Link are also gratefully acknowledged. Mr. Richard Krukowski, Chief Instrument Designer at the Davidson Laboratory provided his usual expertise in assuring proper behavior of all the electronics.

# REFERENCES

1. F. T. Korsmeyer, "Model Test of a Waterjet Propulsion System for High Speed Amphibians," Davidson Laboratory Report R-2362, August, 1983.

2. E. Numata, "Performance Trial of a Manned Waterjet Testcraft," Davidson Laboratory Report R-2390, March, 1985.

3. D. Lueders and E. Numata, "Waterjet Propulsion System Performance in a Manned Testcraft in Calm Water," Davidson Laboratory Report TR-2519, March, 1985.

TABLE 1

MODEL CHARACTERISTICS

($\lambda$ = 1:5.367)

| Test Craft | Particulars |
|---|---|
| Length | 5.33 ft |
| Breadth | 1.25 ft |
| Baseline Trim | 14 deg |
| Transom Draft | 11 in |
| Impeller Diameter | .325 ft |
| Test Section Area | .0479 sq ft |

WaterJet Inlet Particulars

| Configuration | Length in | Width in | Inlet Flow Area sq ft |
|---|---|---|---|
| Stevens | 5.25 | 3.00 | .0654 |
| 21/2.50 | 3.91 | 3.96 | .0614 |
| 27/0 | 5.03 | 3.96 | .0631 |
| 21/0 | 3.91 | 3.96 | .0560 |

## TABLE 2

### Pressure Tap Locations

#### Location of Inlet Static Pressure Taps, Inches

| | Stevens | | 21/2.50 | | 27/0 | | 21/0 | |
|---|---|---|---|---|---|---|---|---|
| | X | Z | X | Z | X | Z | X | Z |
| I1 | 40.25 | -.43 | 36.75 | .83 | 36.75 | 0.37 | 36.75 | 0.37 |
| I2 | 36.00 | 0.30 | 33.12 | 1.03 | 34.00 | 0.66 | 33.12 | 0.66 |
| I3 | 33.69 | 2.25 | 32.13 | 1.96 | 32.25 | 2.13 | 32.20 | 1.60 |
| I4 | 32.62 | 1.00 | 31.39 | 1.20 | 31.50 | 1.32 | 31.50 | 0.98 |

#### Location of Transition Static Pressure Taps, Inches

| | X | Z |
|---|---|---|
| T1 | 29.06 | 0.40 |
| T2 | 29.06 | 1.90 |
| T3 | 29.06 | 3.40 |

#### Location of Test Section Prandtl Tubes, Inches

| | 0° | | 45° | | 90° | |
|---|---|---|---|---|---|---|
| | X | Z | X | Z | X | Z |
| Top | 27.5 | 3.16 | 27.5 | 2.79 | 27.5 | 1.91 |
| 2 | 27.5 | 2.785 | 27.5 | 2.53 | 27.5 | 1.91 |
| 3 | 27.5 | 2.41 | 27.5 | 2.26 | 27.5 | 1.91 |
| 4 | 27.5 | 1.41 | 27.5 | 1.56 | 27.5 | 1.91 |
| 5 | 27.5 | 1.035 | 27.5 | 1.29 | 27.5 | 1.91 |
| Bottom | 27.5 | 0.66 | 27.5 | 1.03 | 27.5 | 1.91 |

#### Location of Impeller Head Pressure Taps, Inches

| | X | Z |
|---|---|---|
| H1 | 18.62 | 4.86 |
| H2 | 17.25 | 5.16 |

X = Horizontal distance forward of transom, inches
Z = Distance above baseline, inches

TABLE 3

Mass Flow Rate for all Inlets
Varying Transition, cfs

| Model Velocity fps | Nominal Impeller rpm | Stevens 8 | 21/2.50 6 | 21/2.50 8 | 21/2.50 10 | 27/0 6 | 27/0 10 | 21/0 6 | 21/0 10 |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 2180 | .70 | | | | | | | |
| 0 | 2800 | .93 | .92 | .90 | .93 | .93 | .96 | .89 | .90 |
| 0 | 3600 | 1.14 | 1.16 | 1.15 | 1.14 | 1.18 | 1.22 | 1.13 | 1.12 |
| 0 | 4300 | | 1.34 | 1.35 | 1.36 | 1.38 | 1.39 | 1.31 | 1.29 |
| 26.5 | 3600 | 1.59 | 1.60 | 1.59 | 1.59 | 1.60 | 1.59 | 1.54 | 1.53 |
| 26.5 | 4300 | 1.79 | 1.79 | 1.76 | 1.76 | 1.77 | 1.78 | 1.69 | 1.73 |
| 26.5 | 5100 | 1.92 | 1.88+ | 1.85+ | 1.88 | 1.90 | 1.93 | 1.80 | 1.79 |

TABLE 4

Velocity Ratios for all Inlets
Varying Transition

| Model Velocity fps | Nominal Impeller rpm | Stevens 8 | 21/2.50 6 | 21/2.50 8 | 21/2.50 10 | 27/0 6 | 27/0 10 | 21/0 6 | 21/0 10 |
|---|---|---|---|---|---|---|---|---|---|
| | | Inlet Velocity Ratio, $V_I/V_O$ | | | | | | | |
| 26.5 | 3600 | .92 | .98 | .98 | .97 | .96 | .95 | 1.03 | 1.03 |
| 26.5 | 4300 | 1.03 | 1.10 | 1.08 | 1.08 | 1.06 | 1.06 | 1.14 | 1.16 |
| 26.5 | 5100 | 1.11 | 1.16+ | 1.13+ | 1.16 | 1.13 | 1.15 | 1.21 | 1.21 |
| | | Test Section Velocity Ratio, $V_T/V_O$ | | | | | | | |
| 26.5 | 3600 | 1.25 | 1.26 | 1.26 | 1.25 | 1.26 | 1.25 | 1.21 | 1.20 |
| 26.5 | 4300 | 1.41 | 1.41 | 1.40 | 1.38 | 1.40 | 1.40 | 1.33 | 1.36 |
| 26.5 | 5100 | 1.51 | 1.48+ | 1.45+ | 1.48 | 1.49 | 1.52 | 1.42 | 1.41 |

+Estimated Value

TABLE 5.1

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 337# | 0.0 | 2175. | 0. | Static | -1.8 | -1.8 | -1.8 | -1.9 | -1.4 | -1.2 | -1.68 | |
| | | | | Dynamic | 1.8 | 1.8 | 1.9 | 1.0 | 1.2 | 0.6 | 1.35 | 0.66 |
| | | | | Total | 0.0 | 0.0 | 0.1 | -0.9 | -0.2 | -0.6 | -0.33 | |
| 372# | 0.0 | 2182. | 45. | Static | -1.8 | -1.8 | -1.9 | -1.6 | -1.7 | -1.9 | -1.88 | |
| | | | | Dynamic | 1.9 | 1.8 | 1.9 | 1.0 | 1.3 | 1.4 | 1.59 | 0.73 |
| | | | | Total | 0.1 | 0.0 | 0.0 | -0.6 | -0.4 | -0.5 | -0.29 | |
| 329# | 0.0 | 2172. | 90. | Static | -1.8 | -1.8 | -1.9 | -1.9 | -1.8 | -1.6 | -1.86 | |
| | | | | Dynamic | 1.8 | 1.9 | 1.7 | 1.7 | 2.8 | 2.4 | 2.10 | 0.84 |
| | | | | Total | 0.0 | 0.1 | -0.2 | -0.2 | 1.0 | 0.8 | 0.24 | |

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 338# | 0.0 | 2808. | 0. | Static | -3.1 | -3.0 | -3.2 | -3.2 | -2.7 | -2.4 | -2.97 | |
| | | | | Dynamic | 3.1 | 3.1 | 3.3 | 1.7 | 2.7 | 1.5 | 2.53 | 0.92 |
| | | | | Total | 0.0 | 0.1 | 0.1 | -1.5 | 0.0 | -0.9 | -0.44 | |
| 373# | 0.0 | 2819. | 45. | Static | -3.2 | -3.1 | -3.2 | -2.9 | -2.8 | -3.0 | -3.13 | |
| | | | | Dynamic | 3.2 | 3.1 | 2.8 | 2.0 | 2.0 | 2.2 | 2.62 | 0.94 |
| | | | | Total | 0.0 | 0.0 | -0.4 | -0.9 | -0.8 | -0.8 | -0.51 | |
| 325# | 0.0 | 2808. | 90. | Static | -3.0 | -3.0 | -3.3 | -3.2 | -2.9 | -2.8 | -3.07 | |
| | | | | Dynamic | 3.1 | 3.0 | 2.7 | 2.6 | 4.3 | 3.7 | 3.34 | 1.06 |
| | | | | Total | 0.1 | 0.0 | -0.6 | -0.6 | 1.2 | 0.9 | 0.27 | |

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 339# | 0.0 | 3528. | 0. | Static | -4.8 | -4.7 | -4.9 | -5.0 | -4.1 | -3.5 | -4.48 | |
| | | | | Dynamic | 4.9 | 4.7 | 5.2 | 2.5 | 3.9 | 1.7 | 3.70 | 1.10 |
| | | | | Total | 0.1 | 0.0 | 0.3 | -2.5 | -0.2 | -1.8 | -0.78 | |
| 374# | 0.0 | 3598. | 45. | Static | -5.1 | -5.0 | -5.3 | -4.7 | -4.5 | -4.9 | -5.03 | |
| | | | | Dynamic | 5.2 | 4.8 | 4.8 | 2.7 | 2.6 | 3.1 | 3.97 | 1.15 |
| | | | | Total | 0.1 | -0.2 | -0.5 | -2.0 | -1.9 | -1.8 | -1.06 | |
| 327# | 0.0 | 3563. | 90. | Static | -4.9 | -4.9 | -5.2 | -5.3 | -4.4 | -4.0 | -4.76 | |
| | | | | Dynamic | 5.0 | 4.9 | 4.8 | 4.2 | 6.1 | 5.3 | 5.14 | 1.32 |
| | | | | Total | 0.1 | 0.0 | -0.4 | -1.1 | 1.7 | 1.2 | 0.38 | |

#No bollard fairing attached at the inlet

TABLE 5.1
(Concluded)

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 341 | 26.5 | 3528. | 0. | Static | -4.8 | -4.8 | -5.1 | -5.1 | -4.7 | -4.7 | -4.91 | |
| | | | | Dynamic | 7.2 | 8.3 | 8.5 | 9.7 | 8.5 | 5.3 | 7.44 | 1.59 |
| | | | | Total | 2.4 | 3.5 | 3.4 | 4.6 | 3.8 | 0.6 | 2.53 | |
| 369 | 26.5 | 3561. | 45. | Static | -4.8 | -4.9 | -5.4 | -4.2 | -4.7 | -5.3 | -5.01 | |
| | | | | Dynamic | 7.0 | 6.6 | 8.1 | 8.7 | 9.3 | 8.3 | 7.89 | 1.64 |
| | | | | Total | 2.2 | 1.7 | 2.7 | 4.5 | 4.6 | 3.0 | 2.88 | |
| 322 | 26.5 | 3575. | 90. | Static | -4.6 | -4.5 | -4.6 | -5.0 | -4.1 | -4.4 | -4.60 | |
| | | | | Dynamic | 7.1 | 8.6 | 8.1 | 8.6 | 8.8 | 7.4 | 7.90 | 1.64 |
| | | | | Total | 2.5 | 4.1 | 3.5 | 3.6 | 4.7 | 3.0 | 3.30 | |

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 342 | 26.5 | 4320. | 0. | Static | -6.0 | -5.9 | -6.0 | -6.0 | -5.1 | -5.5 | -5.83 | |
| | | | | Dynamic | 8.5 | 9.5 | 9.6 | 10.6 | 8.5 | 5.9 | 8.27 | 1.67 |
| | | | | Total | 2.5 | 3.6 | 3.6 | 4.6 | 3.4 | 0.4 | 2.44 | |
| 370 | 26.5 | 4357. | 45. | Static | -7.2 | -7.3 | -7.8 | -6.8 | -6.9 | -7.7 | -7.41 | |
| | | | | Dynamic | 9.3 | 8.9 | 10.3 | 11.2 | 11.6 | 10.9 | 10.28 | 1.87 |
| | | | | Total | 2.1 | 1.6 | 2.5 | 4.4 | 4.7 | 3.2 | 2.87 | |
| 324 | 26.5 | 4289. | 90. | Static | -6.7 | -6.5 | -6.3 | -6.9 | -5.5 | -5.9 | -6.35 | |
| | | | | Dynamic | 9.6 | 10.4 | 9.8 | 10.8 | 10.6 | 9.4 | 9.95 | 1.84 |
| | | | | Total | 2.9 | 3.9 | 3.5 | 3.9 | 5.1 | 3.5 | 3.60 | |

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 343 | 26.5 | 4869. | 0. | Static | -6.4 | -6.3 | -6.2 | -6.1 | -5.3 | -6.1 | -6.21 | |
| | | | | Dynamic | 9.0 | 9.7 | 9.8 | 10.8 | 8.3 | 6.6 | 8.62 | 1.71 |
| | | | | Total | 2.6 | 3.4 | 3.6 | 4.7 | 3.0 | 0.5 | 2.41 | |
| 371 | 26.5 | 5130. | 45. | Static | -9.9 | -9.6 | -9.7 | -9.5 | -9.7 | -10.2 | -9.93 | |
| | | | | Dynamic | 11.9 | 11.2 | 12.1 | 13.8 | 15.0 | 11.5 | 12.37 | 2.05 |
| | | | | Total | 2.0 | 1.6 | 2.4 | 4.3 | 5.3 | 1.3 | 2.44 | |
| 324 | 26.5 | 4289. | 90. | Static | -6.7 | -6.5 | -6.3 | -6.9 | -5.5 | -5.9 | -6.35 | |
| | | | | Dynamic | 9.6 | 10.4 | 9.8 | 10.8 | 10.6 | 9.4 | 9.95 | 1.84 |
| | | | | Total | 2.9 | 3.9 | 3.5 | 3.9 | 5.1 | 3.5 | 3.60 | |
| 323 | 26.5 | 5068. | 90. | Static | -9.4 | -9.1 | -7.7 | -8.4 | -7.3 | -7.7 | -8.43 | |
| | | | | Dynamic | 12.1 | 12.9 | 11.0 | 11.9 | 12.8 | 11.3 | 11.99 | 2.02 |
| | | | | Total | 2.7 | 3.8 | 3.3 | 3.5 | 5.5 | 3.6 | 3.56 | |

TABLE 5.2

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 405 | 0.0 | 2826. | 0. | Static | -3.5 | -3.5 | -3.4 | -3.2 | -3.3 | -3.4 | -3.48. | |
| | | | | Dynamic | 3.4 | 3.5 | 3.4 | 2.8 | 1.2 | 0.5 | 2.29 | 0.84 |
| | | | | Total | -0.1 | 0.0 | 0.0 | -0.4 | -2.1 | -2.9 | -1.19 | |
| 377# | 0.0 | 2826. | 45. | Static | -3.4 | -3.5 | -3.9 | -3.0 | -3.0 | -3.2 | -3.39 | |
| | | | | Dynamic | 3.5 | 3.4 | 3.2 | 1.2 | 0.5 | 0.1 | 1.90 | 0.70 |
| | | | | Total | 0.1 | -0.1 | -0.7 | -1.8 | -2.5 | -3.1 | -1.49 | |
| 446 | 0.0 | 2798. | 90. | Static | -2.7 | -2.6 | -2.9 | -2.3 | -2.6 | -3.1 | -2.85 | |
| | | | | Dynamic | 2.8 | 2.7 | 2.7 | 2.2 | 2.7 | 3.3 | 2.84 | 0.98 |
| | | | | Total | 0.1 | 0.1 | -0.2 | -0.1 | 0.1 | 0.2 | -0.01 | |

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 406 | 0.0 | 3532. | 0. | Static | -5.4 | -5.4 | -5.4 | -5.0 | -5.1 | -5.2 | -5.36 | |
| | | | | Dynamic | 5.4 | 5.0 | 5.3 | 4.7 | 2.4 | 0.8 | 3.66 | 1.06 |
| | | | | Total | 0.0 | -0.4 | -0.1 | -0.3 | -2.7 | -4.4 | -1.70 | |
| 376# | 0.0 | 3535. | 45. | Static | -5.2 | -5.3 | -5.8 | -4.7 | -4.4 | -4.9 | -5.12 | |
| | | | | Dynamic | 5.3 | 4.8 | 5.0 | 2.1 | 1.0 | -0.2 | 2.84 | 0.83 |
| | | | | Total | 0.1 | -0.5 | -0.8 | -2.6 | -3.4 | -5.1 | -2.28 | |
| 447 | 0.0 | 3523. | 90. | Static | -4.3 | -4.3 | -4.7 | -3.7 | -4.2 | -5.0 | -4.54 | |
| | | | | Dynamic | 4.5 | 4.1 | 4.4 | 3.7 | 4.3 | 5.2 | 4.49 | 1.24 |
| | | | | Total | 0.2 | -0.2 | -0.3 | 0.0 | 0.1 | 0.2 | -0.05 | |

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 407 | 0.0 | 4218. | 0. | Static | -7.4 | -7.3 | -7.5 | -6.9 | -6.9 | -7.0 | -7.28 | |
| | | | | Dynamic | 7.4 | 7.0 | 7.5 | 5.8 | 2.4 | 0.9 | 4.80 | 1.20 |
| | | | | Total | 0.0 | -0.3 | 0.0 | -1.1 | -4.5 | -6.1 | -2.48 | |
| 378# | 0.0 | 4296. | 45. | Static | -7.5 | -7.4 | -8.0 | -6.7 | -6.3 | -6.9 | -7.21 | |
| | | | | Dynamic | 7.5 | 6.9 | 7.2 | 3.2 | 1.3 | -0.4 | 4.03 | 0.99 |
| | | | | Total | 0.0 | -0.5 | -0.8 | -3.5 | -5.0 | -7.3 | -3.18 | |
| 448 | 0.0 | 4262. | 90. | Static | -6.0 | -5.9 | -6.3 | -4.9 | -5.7 | -6.7 | -6.14 | |
| | | | | Dynamic | 6.1 | 5.5 | 6.1 | 4.9 | 5.8 | 6.9 | 6.05 | 1.44 |
| | | | | Total | 0.1 | -0.4 | -0.2 | 0.0 | 0.1 | 0.2 | -0.09 | |

#No bollard fairing attached at the inlet

TABLE 5.2
(Concluded)

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 409 | 26.5 | 3[illegible]0. | 0. | Static | -5.9 | -6.3 | -6.3 | -5.4 | -5.7 | -5.8 | -6.00 | |
| | | | | Dynamic | 8.1 | 7.1 | 8.8 | 10.1 | 5.6 | 4.5 | 6.91 | 1.52 |
| | | | | Total | 2.2 | 0.8 | 2.5 | 4.7 | -0.1 | -1.3 | 0.91 | |
| 379 | 26.5 | 3583. | 45. | Static | -5.4 | -5.4 | -5.9 | -4.9 | -5.5 | -5.7 | -5.59 | |
| | | | | Dynamic | 8.2 | 8.0 | 9.1 | 9.6 | 10.9 | 6.2 | 8.27 | 1.67 |
| | | | | Total | 2.8 | 2.6 | 3.2 | 4.7 | 5.4 | 0.5 | 2.68 | |
| 450 | 26.5 | 3597. | 90. | Static | -4.6 | -4.7 | -4.9 | -3.6 | -4.3 | -5.0 | -4.72 | |
| | | | | Dynamic | 7.2 | 8.3 | 9.0 | 6.9 | 9.2 | 9.0 | 8.27 | 1.68 |
| | | | | Total | 2.6 | 3.6 | 4.1 | 3.3 | 4.9 | 4.0 | 3.55 | |

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 410 | 26.5 | 4343. | 0. | Static | -8.0 | -8.5 | -8.4 | -7.8 | -7.8 | -8.1 | -8.18 | |
| | | | | Dynamic | 10.2 | 9.1 | 10.6 | 10.0+ | 5.3 | 4.5 | 7.87 | 1.64 |
| | | | | Total | 2.2 | 0.6 | 2.2 | 2.2+ | -2.5 | -3.6 | -0.31 | |
| 380 | 26.5 | 4321. | 45. | Static | -7.7 | -7.7 | -8.1 | -6.9 | -7.6 | -8.1 | -7.85 | |
| | | | | Dynamic | 10.5 | 9.8 | 11.0 | 11.1 | 12.6 | 8.9 | 10.41 | 1.88 |
| | | | | Total | 2.8 | 2.1 | 2.9 | 4.2 | 5.0 | 0.8 | 2.56 | |
| 451 | 26.5 | 4339. | 90. | Static | -6.9 | -6.5 | -6.9 | -5.6 | -6.3 | -7.4 | -6.87 | |
| | | | | Dynamic | 10.8 | 10.3 | 11.4 | 8.8 | 11.3 | 11.9 | 10.94 | 1.93 |
| | | | | Total | 3.9 | 3.8 | 4.5 | 3.2 | 5.0 | 4.5 | 4.07 | |

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 411* | 0.0 | 3507. | 0. | Static | -4.9 | -5.2 | -5.5 | -6.1 | -4.9 | -6.7 | -5.66 | |
| | | | | Dynamic | 9.2 | 8.6 | 9.1 | 55.5 | 6.5 | 6.0 | 12.29 | 1.88 |
| | | | | Total | 4.3 | 3.4 | 3.6 | 49.4 | 1.6 | -0.7 | 6.63 | |
| 381 | 26.5 | 5045. | 45. | Static | -9.4 | -9.2 | -9.6 | -8.3 | -9.2 | -9.5 | -9.37 | |
| | | | | Dynamic | 12.8 | 11.3 | 12.0 | 11.7 | 13.6 | 9.7 | 11.74 | 2.00 |
| | | | | Total | 3.6 | 2.1 | 2.4 | 3.4 | 4.4 | 0.2 | 2.37 | |
| 453 | 26.5 | 5085. | 90. | Static | -8.0 | -7.8 | -8.2 | -6.9 | -7.5 | -8.8 | -8.09 | |
| | | | | Dynamic | 11.9 | 11.6 | 12.2 | 10.4 | 12.6 | 13.5 | 12.25 | 2.04 |
| | | | | Total | 3.9 | 3.8 | 4.0 | 3.5 | 5.1 | 4.7 | 4.16 | |

*Run is no good
+Estimated value

TABLE 5.3

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 416 | 0.0 | 2790. | 0. | Static | -3.4 | -3.3 | -3.4 | -3.2 | -3.1 | -3.2 | -3.35 | |
| | | | | Dynamic | 3.3 | 3.3 | 3.4 | 2.8 | 1.1 | 0.2 | 2.16 | 0.79 |
| | | | | Total | -0.1 | 0.0 | 0.0 | -0.6 | -2.0 | -3.0 | -1.19 | |
| 438 | 0.0 | 2816. | 45. | Static | -3.5 | -3.3 | -3.3 | -3.1 | -3.2 | -3.6 | -3.46 | |
| | | | | Dynamic | 3.5 | 3.3 | 3.2 | 3.2 | 2.5 | 1.8 | 2.85 | 0.98 |
| | | | | Total | 0.0 | 0.0 | -0.1 | 0.1 | -0.7 | -1.8 | -0.61 | |
| 455 | 0.0 | 2822. | 90. | Static | -2.9 | -2.8 | -3.1 | -1.9 | -2.8 | -3.1 | -2.93 | |
| | | | | Dynamic | 3.0 | 2.9 | 2.9 | 1.8 | 2.9 | 3.2 | 2.90 | 0.99 |
| | | | | Total | 0.1 | 0.1 | -0.2 | -0.1 | 0.1 | 0.1 | -0.03 | |
| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
| 417 | 0.0 | 3550. | 0. | Static | -5.3 | -5.2 | -5.3 | -5.1 | -4.9 | -5.7 | -5.41 | |
| | | | | Dynamic | 5.2 | 5.1 | 5.2 | 4.4 | 1.6 | 1.1 | 3.54 | 1.05 |
| | | | | Total | -0.1 | -0.1 | -0.1 | -0.7 | -3.3 | -4.6 | -1.87 | |
| 439 | 0.0 | 3588. | 45. | Static | -5.9 | -5.4 | -5.5 | -5.1 | -5.0 | -5.9 | -5.69 | |
| | | | | Dynamic | 6.0 | 5.2 | 5.2 | 5.1 | 4.0 | 2.8 | 4.60 | 1.24 |
| | | | | Total | 0.1 | -0.2 | -0.3 | 0.0 | -1.0 | -3.1 | -1.09 | |
| 456 | 0.0 | 3560. | 90. | Static | -4.7 | -4.5 | -4.9 | -3.4 | -4.5 | -5.1 | -4.71 | |
| | | | | Dynamic | 4.5 | 4.3 | 4.8 | 3.0 | 4.6 | 5.2 | 4.54 | 1.24 |
| | | | | Total | -0.2 | -0.2 | -0.1 | -0.4 | 0.1 | 0.1 | -0.17 | |
| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
| 418 | 0.0 | 4255. | 0. | Static | -7.6 | -7.4 | -7.6 | -7.2 | -7.0 | -7.8 | -7.60 | |
| | | | | Dynamic | 7.5 | 7.1 | 7.5 | 5.9 | 2.3 | 1.2 | 4.91 | 1.23 |
| | | | | Total | -0.1 | -0.3 | -0.1 | -1.3 | -4.7 | -6.6 | -2.69 | |
| 440 | 0.0 | 4296. | 45. | Static | -7.7 | -7.1 | -7.4 | -7.0 | -6.8 | -7.6 | -7.47 | |
| | | | | Dynamic | 7.9 | 6.7 | 7.0 | 6.5 | 4.8 | 4.5 | 6.17 | 1.44 |
| | | | | Total | 0.2 | -0.4 | -0.4 | -0.5 | -2.0 | -3.1 | -1.30 | |
| 457 | 0.0 | 4271. | 90. | Static | -6.3 | -6.2 | -6.6 | -4.5 | -6.0 | -6.8 | -6.32 | |
| | | | | Dynamic | 6.4 | 5.8 | 6.4 | 3.9 | 6.2 | 7.0 | 6.19 | 1.45 |
| | | | | Total | 0.1 | -0.4 | -0.2 | -0.6 | 0.2 | 0.2 | -0.13 | |

TABLE 5.3
(Concluded)

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 422 | 26.5 | 3568. | 0. | Static | -5.5 | -5.9 | -6.0 | -5.5 | -5.5 | -6.1 | -5.86 | |
| | | | | Dynamic | 8.0 | 7.0 | 8.5 | 8.7 | 4.7 | 4.5 | 6.56 | 1.48 |
| | | | | Total | 2.5 | 1.1 | 2.5 | 3.2 | -0.8 | -1.6 | 0.70 | |
| 442 | 26.5 | 3583. | 45. | Static | -5.9 | -5.7 | -5.9 | -5.3 | -5.3 | -6.1 | -5.86 | |
| | | | | Dynamic | 8.9 | 8.1 | 8.9 | 7.1 | 9.6 | 6.7 | 8.14 | 1.66 |
| | | | | Total | 3.0 | 2.4 | 3.0 | 1.8 | 4.3 | 0.6 | 2.28 | |
| 458 | 26.5 | 3658. | 90. | Static | -4.7 | -4.7 | -5.0 | -2.9 | -4.6 | -5.2 | -4.77 | |
| | | | | Dynamic | 8.5 | 8.7 | 9.3 | 6.4 | 9.2 | 9.5 | 8.78 | 1.73 |
| | | | | Total | 3.8 | 4.0 | 4.3 | 3.5 | 4.6 | 4.3 | 4.01 | |

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 423 | 26.5 | 4367. | 0. | Static | -7.8 | -8.4 | -8.3 | -7.9 | -7.8 | -9.0 | -8.34 | |
| | | | | Dynamic | 9.9 | 9.0 | 10.3 | 9.0 | 4.6 | 4.4 | 7.51 | 1.58 |
| | | | | Total | 2.1 | 0.6 | 2.0 | 1.1 | -3.2 | -4.6 | -0.83 | |
| 444 | 26.5 | 4331. | 45. | Static | -8.2 | -7.7 | -7.3 | -7.6 | -7.3 | -8.3 | -7.96 | |
| | | | | Dynamic | 11.3 | 10.2 | 11.0 | 9.4 | 11.6 | 9.1 | 10.43 | 1.88 |
| | | | | Total | 3.1 | 2.5 | 3.7 | 1.8 | 4.3 | 0.8 | 2.47 | |
| 459 | 26.5 | 4333. | 90. | Static | -6.6 | -6.5 | -6.9 | -4.2 | -6.3 | -7.4 | -6.61 | |
| | | | | Dynamic | 10.2 | 10.0 | 10.9 | 7.1 | 10.8 | 11.3 | 10.31 | 1.87 |
| | | | | Total | 3.6 | 3.5 | 4.0 | 2.9 | 4.5 | 3.9 | 3.70 | |

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 425 | 26.5 | 5106. | 0. | Static | -10.4 | -10.5 | -9.7 | -10.3 | -9.3 | -11.1 | -10.44 | |
| | | | | Dynamic | 12.2 | 11.0 | 12.3 | 10.4 | 4.6 | 4.6 | 8.76 | 1.69 |
| | | | | Total | 1.8 | 0.5 | 2.6 | 0.1 | -4.7 | -6.5 | -1.68 | |
| 445 | 26.5 | 5169. | 45. | Static | -9.7 | -9.3 | -9.3 | -9.9 | -8.8 | -10.5 | -9.78 | |
| | | | | Dynamic | 13.7 | 12.4 | 11.7 | 11.2 | 12.0 | 10.9 | 12.10 | 2.03 |
| | | | | Total | 4.0 | 3.1 | 2.4 | 1.3 | 3.2 | 0.4 | 2.32 | |
| 460* | 26.5 | 3987. | 90. | Static | -6.4 | -6.4 | -7.2 | -4.5 | -6.5 | -7.1 | -6.59 | |
| | | | | Dynamic | 9.4 | 9.1 | 9.5 | 6.6 | 9.6 | 10.3 | 9.38 | 1.79 |
| | | | | Total | 3.0 | 2.7 | 2.3 | 2.1 | 3.1 | 3.2 | 2.79 | |

*Run is no good

TABLE 5.4

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 402 | 0.0 | 2796. | 0. | Static | -3.4 | -3.3 | -3.5 | -3.2 | -3.0 | -3.2 | -3.36 | |
| | | | | Dynamic | 3.4 | 3.4 | 3.5 | 3.1 | 1.6 | 0.3 | 2.33 | 0.83 |
| | | | | Total | 0.0 | 0.1 | 0.0 | -0.1 | -1.4 | -2.9 | -1.03 | |
| 389 | 0.0 | 2876. | 45. | Static | -3.5 | -3.6 | -3.7 | -3.3 | -3.2 | -3.4 | -3.53 | |
| | | | | Dynamic | 3.6 | 3.6 | 3.1 | 3.2 | 2.7 | 2.4 | 3.05 | 1.02 |
| | | | | Total | 0.1 | 0.0 | -0.6 | -0.1 | -0.5 | -1.0 | -0.48 | |
| 465 | 0.0 | 2817. | 90. | Static | -2.9 | -2.9 | -3.0 | -2.4 | -2.8 | -3.3 | -3.04 | |
| | | | | Dynamic | 3.1 | 3.0 | 3.0 | 2.2 | 2.9 | 3.5 | 3.07 | 1.02 |
| | | | | Total | 0.2 | 0.1 | 0.0 | -0.2 | 0.1 | 0.2 | 0.03 | |
| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
| 403 | 0.0 | 3528. | 0. | Static | -5.5 | -5.4 | -5.5 | -5.1 | -4.9 | -5.0 | -5.33 | |
| | | | | Dynamic | 5.5 | 5.2 | 5.5 | 4.4 | 1.7 | 0.2 | 3.44 | 0.98 |
| | | | | Total | 0.0 | -0.2 | 0.0 | -0.7 | -3.2 | -4.8 | -1.89 | |
| 390 | 0.0 | 3550. | 45. | Static | -5.2 | -5.2 | -5.6 | -5.0 | -4.7 | -4.9 | -5.17 | |
| | | | | Dynamic | 5.4 | 5.0 | 4.8 | 4.9 | 3.2 | 3.3 | 4.34 | 1.21 |
| | | | | Total | 0.2 | -0.2 | -0.8 | -0.1 | -1.5 | -1.6 | -0.83 | |
| 466 | 0.0 | 3560. | 90. | Static | -4.9 | -4.6 | -5.1 | -4.8 | -4.6 | -5.3 | -5.01 | |
| | | | | Dynamic | 5.0 | 4.3 | 5.1 | 4.2 | 4.8 | 5.6 | 4.93 | 1.30 |
| | | | | Total | 0.1 | -0.3 | 0.0 | -0.6 | 0.2 | 0.3 | -0.08 | |
| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
| 404 | 0.0 | 4280. | 0. | Static | -7.8 | -7.6 | -7.7 | -7.1 | -6.9 | -7.0 | -7.46 | |
| | | | | Dynamic | 7.8 | 7.3 | 7.7 | 6.4 | 2.6 | 0.7 | 4.98 | 1.21 |
| | | | | Total | 0.0 | -0.3 | 0.0 | -0.7 | -4.3 | -6.3 | -2.48 | |
| 391 | 0.0 | 4312. | 45. | Static | -7.4 | -7.2 | -7.2 | -6.9 | -6.6 | -6.8 | -7.13 | |
| | | | | Dynamic | 7.5 | 6.8 | 6.8 | 6.8 | 5.3 | 4.5 | 6.16 | 1.44 |
| | | | | Total | 0.1 | -0.4 | -0.4 | -0.1 | -1.3 | -2.3 | -0.97 | |
| 467 | 0.0 | 4271. | 90. | Static | -6.6 | -6.3 | -6.8 | -6.1 | -6.2 | -7.0 | -6.67 | |
| | | | | Dynamic | 6.8 | 5.8 | 6.8 | 5.3 | 6.4 | 7.2 | 6.56 | 1.50 |
| | | | | Total | 0.2 | -0.5 | 0.0 | -0.8 | 0.2 | 0.2 | -0.11 | |

TABLE 5.4
(Concluded)

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 399 | 26.5 | 3567. | 0. | Static | -5.7 | -5.9 | -5.8 | -5.6 | -5.4 | -5.6 | -5.76 | |
| | | | | Dynamic | 7.8 | 6.7 | 8.7 | 8.8 | 4.2 | 3.5 | 6.20 | 1.43 |
| | | | | Total | 2.1 | 0.8 | 2.9 | 3.2 | -1.2 | -2.1 | 0.44 | |
| 394 | 26.5 | 3566. | 45. | Static | -5.5 | -5.4 | -5.4 | -5.3 | -5.4 | -5.7 | -5.58 | |
| | | | | Dynamic | 7.6 | 7.5 | 8.9 | 9.8 | 10.8 | 6.9 | 8.23 | 1.67 |
| | | | | Total | 2.1 | 2.1 | 3.5 | 4.5 | 5.4 | 1.2 | 2.65 | |
| 468 | 26.5 | 3579. | 90. | Static | -4.7 | -4.6 | -4.9 | -4.4 | -4.3 | -5.1 | -4.81 | |
| | | | | Dynamic | 8.5 | 8.5 | 9.2 | 8.1 | 8.9 | 9.3 | 8.78 | 1.73 |
| | | | | Total | 3.8 | 3.9 | 4.3 | 3.7 | 4.6 | 4.2 | 3.97 | |

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 400 | 26.5 | 4318. | 0. | Static | -7.8 | -8.1 | -7.7 | -7.7 | -7.4 | -7.7 | -7.84 | |
| | | | | Dynamic | 9.9 | 8.6 | 10.2 | 10.0 | 4.5 | 3.0 | 7.17 | 1.52 |
| | | | | Total | 2.1 | 0.5 | 2.5 | 2.3 | -2.9 | -4.7 | -0.67 | |
| 395 | 26.5 | 4354. | 45. | Static | -7.8 | -7.5 | -7.5 | -7.8 | -7.3 | -7.7 | -7.72 | |
| | | | | Dynamic | 11.3 | 10.2 | 10.1 | 11.9 | 11.2 | 8.3 | 10.28 | 1.87 |
| | | | | Total | 3.5 | 2.7 | 2.6 | 4.1 | 3.9 | 0.6 | 2.56 | |
| 470 | 26.5 | 4352. | 90. | Static | -6.9 | -6.7 | -7.0 | -6.4 | -6.4 | -7.5 | -6.99 | |
| | | | | Dynamic | 10.7 | 10.3 | 10.7 | 9.5 | 11.1 | 11.6 | 10.80 | 1.92 |
| | | | | Total | 3.8 | 3.6 | 3.7 | 3.1 | 4.7 | 4.1 | 3.81 | |

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 401 | 26.5 | 5102. | 0. | Static | -10.3 | -10.5 | -9.5 | -9.8 | -8.9 | -9.4 | -9.85 | |
| | | | | Dynamic | 12.3 | 11.2 | 12.1 | 10.7 | 4.4 | 3.4 | 8.51 | 1.65 |
| | | | | Total | 2.0 | 0.7 | 2.6 | 0.9 | -4.5 | -6.0 | -1.34 | |
| 397 | 26.5 | 5148. | 45. | Static | -9.7 | -9.5 | -9.4 | -9.7 | -8.9 | -9.6 | -9.60 | |
| | | | | Dynamic | 13.1 | 12.3 | 12.0 | 12.8 | 11.8 | 9.0 | 11.60 | 1.99 |
| | | | | Total | 3.4 | 2.8 | 2.6 | 3.1 | 2.9 | -0.6 | 2.00 | |
| 472 | 26.5 | 5033. | 90. | Static | -8.2 | -7.8 | -8.2 | -8.0 | -7.6 | -9.3 | -8.40 | |
| | | | | Dynamic | 12.0 | 11.3 | 11.8 | 11.1 | 12.4 | 14.0 | 12.35 | 2.05 |
| | | | | Total | 3.8 | 3.5 | 3.6 | 3.1 | 4.8 | 4.7 | 3.95 | |

TABLE 5.5

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 493 | 0.0 | 2799. | 0. | Static | -3.1 | -3.1 | -3.2 | -3.2 | -3.2 | -3.3 | -3.30 | |
| | | | | Dynamic | 3.2 | 3.2 | 3.2 | 2.4 | 0.9 | 0.6 | 2.12 | 0.81 |
| | | | | Total | 0.1 | 0.1 | 0.0 | -0.8 | -2.3 | -2.7 | -1.18 | |
| 501 | 0.0 | 2816. | 45. | Static | -3.2 | -3.2 | -3.3 | -3.1 | -3.1 | -3.6 | -3.37 | |
| | | | | Dynamic | 3.3 | 3.3 | 3.1 | 3.0 | 2.9 | 3.6 | 3.25 | 1.05 |
| | | | | Total | 0.1 | 0.1 | -0.2 | -0.1 | -0.2 | 0.0 | -0.12 | |
| 476 | 0.0 | 2810. | 90. | Static | -2.7 | -2.7 | -2.9 | -2.6 | -2.6 | -3.0 | -2.88 | |
| | | | | Dynamic | 2.8 | 2.8 | 2.6 | 2.1 | 2.8 | 3.1 | 2.81 | 0.98 |
| | | | | Total | 0.1 | 0.1 | -0.3 | -0.5 | 0.2 | 0.1 | -0.07 | |

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 495 | 0.0 | 3542. | 0. | Static | -5.2 | -5.2 | -5.2 | -5.2 | -5.1 | -5.3 | -5.28 | |
| | | | | Dynamic | 5.2 | 4.9 | 5.0 | 4.1 | 1.8 | 0.7 | 3.35 | 1.01 |
| | | | | Total | 0.0 | -0.3 | -0.2 | -1.1 | -3.4 | -4.6 | -1.93 | |
| 502 | 0.0 | 3579. | 45. | Static | -5.2 | -5.1 | -5.3 | -5.1 | -4.9 | -5.5 | -5.32 | |
| | | | | Dynamic | 5.3 | 4.9 | 4.9 | 4.5 | 4.3 | 5.2 | 4.94 | 1.30 |
| | | | | Total | 0.1 | -0.2 | -0.4 | -0.6 | -0.6 | -0.3 | -0.38 | |
| 477 | 0.0 | 3552. | 90. | Static | -4.5 | -4.5 | -4.7 | -4.3 | -4.4 | -4.9 | -4.71 | |
| | | | | Dynamic | 4.7 | 4.4 | 4.5 | 3.8 | 4.6 | 5.2 | 4.63 | 1.26 |
| | | | | Total | 0.2 | -0.1 | -0.2 | -0.5 | 0.2 | 0.3 | -0.08 | |

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 496 | 0.0 | 4296. | 0. | Static | -7.3 | -7.3 | -7.2 | -7.2 | -7.1 | -7.5 | -7.40 | |
| | | | | Dynamic | 7.2 | 6.8 | 7.1 | 5.2 | 2.4 | 0.7 | 4.59 | 1.17 |
| | | | | Total | -0.1 | -0.5 | -0.1 | -2.0 | -4.7 | -6.8 | -2.81 | |
| 503 | 0.0 | 4291. | 45. | Static | -7.1 | -6.8 | -7.0 | -7.0 | -6.7 | -7.4 | -7.15 | |
| | | | | Dynamic | 7.3 | 6.4 | 6.7 | 6.2 | 6.3 | 6.7 | 6.71 | 1.51 |
| | | | | Total | 0.2 | -0.4 | -0.3 | -0.8 | -0.4 | -0.7 | -0.44 | |
| 478 | 0.0 | 4288. | 90. | Static | -6.3 | -6.1 | -6.5 | -5.8 | -6.1 | -6.7 | -6.38 | |
| | | | | Dynamic | 6.4 | 5.6 | 6.0 | 5.5 | 6.4 | 6.9 | 6.30 | 1.47 |
| | | | | Total | 0.1 | -0.5 | -0.5 | -0.3 | 0.3 | 0.2 | -0.08 | |

TABLE 5.5
(Concluded)

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 497 | 26.5 | 3574. | 0. | Static | -5.2 | -5.6 | -5.3 | -5.5 | -5.4 | -5.3 | -5.45 | |
| | | | | Dynamic | 7.3 | 7.0 | 7.4 | 7.7 | 3.9 | 4.1 | 5.97 | 1.41 |
| | | | | Total | 2.1 | 1.4 | 2.1 | 2.2 | -1.5 | -1.2 | 0.52 | |
| 504 | 26.5 | 3596. | 45. | Static | -5.2 | -5.2 | -5.4 | -5.2 | -5.0 | -5.5 | -5.34 | |
| | | | | Dynamic | 8.2 | 8.8 | 7.9 | 9.3 | 9.5 | 9.2 | 8.83 | 1.74 |
| | | | | Total | 3.0 | 3.7 | 2.6 | 4.0 | 4.5 | 3.8 | 3.49 | |
| 480 | 26.5 | 3528. | 90. | Static | -4.2 | -4.2 | -4.4 | -4.4 | -4.1 | -4.6 | -4.43 | |
| | | | | Dynamic | 7.8 | 8.2 | 7.9 | 7.4 | 8.4 | 8.7 | 8.13 | 1.67 |
| | | | | Total | 3.6 | 4.0 | 3.5 | 3.0 | 4.3 | 4.1 | 3.70 | |
| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
| 498 | 26.5 | 4340. | 0. | Static | -7.4 | -7.7 | -7.3 | -7.7 | -7.6 | -8.0 | -7.72 | |
| | | | | Dynamic | 9.7 | 9.3 | 9.6 | 8.7 | 4.1 | 4.0 | 7.23 | 1.54 |
| | | | | Total | 2.3 | 1.6 | 2.3 | 1.0 | -3.5 | -4.0 | -0.49 | |
| 505 | 26.5 | 4384. | 45. | Static | -7.4 | -7.2 | -7.2 | -7.4 | -7.0 | -7.7 | -7.44 | |
| | | | | Dynamic | 10.4 | 10.9 | 10.0 | 11.0 | 10.8 | 10.9 | 10.69 | 1.91 |
| | | | | Total | 3.0 | 3.7 | 2.8 | 3.6 | 3.8 | 3.2 | 3.25 | |
| 481 | 26.5 | 4373. | 90. | Static | -6.4 | -6.3 | -6.5 | -6.5 | -6.3 | -7.2 | -6.67 | |
| | | | | Dynamic | 9.9 | 10.0 | 9.7 | 9.6 | 10.8 | 11.5 | 10.42 | 1.89 |
| | | | | Total | 3.5 | 3.7 | 3.2 | 3.1 | 4.5 | 4.3 | 3.75 | |
| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
| 499 | 26.5 | 5099. | 0. | Static | -10.2 | -10.5 | -10.0 | -10.0 | -9.3 | -10.3 | -10.20 | |
| | | | | Dynamic | 12.6 | 12.1 | 12.5 | 9.1 | 3.9 | 4.0 | 8.69 | 1.67 |
| | | | | Total | 2.4 | 1.6 | 2.5 | -0.9 | -5.4 | -5.3 | -1.51 | |
| 506 | 26.5 | 5132. | 45. | Static | -9.6 | -9.4 | -9.1 | -9.6 | -9.0 | -9.5 | -9.51 | |
| | | | | Dynamic | 12.7 | 13.0 | 11.9 | 12.1 | 12.2 | 12.7 | 12.55 | 2.07 |
| | | | | Total | 3.1 | 3.6 | 2.8 | 2.5 | 3.2 | 3.2 | 3.04 | |
| 485 | 26.5 | 5103. | 90. | Static | -7.4 | -7.0 | -7.0 | -7.6 | -6.9 | -8.4 | -7.59 | |
| | | | | Dynamic | 10.5 | 10.2 | 9.8 | 10.3 | 11.0 | 12.1 | 10.87 | 1.93 |
| | | | | Total | 3.1 | 3.2 | 2.8 | 2.7 | 4.1 | 3.7 | 3.28 | |

TABLE 5.6

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 513 | 0.0 | 2827. | 0. | Static | -3.3 | -3.3 | -3.2 | -3.3 | -3.1 | -3.5 | -3.41 | |
| | | | | Dynamic | 3.3 | 3.3 | 3.2 | 2.8 | 1.2 | 0.4 | 2.19 | 0.81 |
| | | | | Total | 0.0 | 0.0 | 0.0 | -0.5 | -1.9 | -3.1 | -1.22 | |
| 507 | 0.0 | 2849. | 45. | Static | -3.4 | -3.3 | -3.2 | -3.4 | -3.1 | -3.6 | -3.47 | |
| | | | | Dynamic | 3.5 | 3.4 | 3.2 | 3.3 | 3.2 | 3.8 | 3.46 | 1.09 |
| | | | | Total | 0.1 | 0.1 | 0.0 | -0.1 | 0.1 | 0.2 | -0.01 | |
| 487 | 0.0 | 2799. | 90. | Static | -3.0 | -2.8 | -2.9 | -3.1 | -2.9 | -3.2 | -3.09 | |
| | | | | Dynamic | 3.1 | 3.0 | 2.4 | 2.7 | 3.0 | 3.5 | 3.07 | 1.02 |
| | | | | Total | 0.1 | 0.2 | -0.5 | -0.4 | 0.1 | 0.3 | -0.02 | |
| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
| 514 | 0.0 | 3594. | 0. | Static | -5.4 | -5.4 | -5.3 | -5.1 | -5.1 | -5.7 | -5.48 | |
| | | | | Dynamic | 5.4 | 5.1 | 5.1 | 3.9 | 1.8 | 0.7 | 3.44 | 1.02 |
| | | | | Total | 0.0 | -0.3 | -0.2 | -1.2 | -3.3 | -5.0 | -2.04 | |
| 508 | 0.0 | 3587. | 45. | Static | -5.3 | -5.2 | -5.1 | -5.2 | -4.9 | -5.6 | -5.37 | |
| | | | | Dynamic | 5.4 | 5.0 | 5.0 | 5.0 | 4.9 | 5.9 | 5.33 | 1.35 |
| | | | | Total | 0.1 | -0.2 | -0.1 | -0.2 | 0.0 | 0.3 | -0.04 | |
| 488 | 0.0 | 3578. | 90. | Static | -4.8 | -4.7 | -4.8 | -4.9 | -4.6 | -5.1 | -4.95 | |
| | | | | Dynamic | 5.1 | 4.6 | 4.2 | 4.6 | 4.9 | 5.4 | 4.93 | 1.30 |
| | | | | Total | 0.3 | -0.1 | -0.6 | -0.3 | 0.3 | 0.3 | -0.02 | |
| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
| 515 | 0.0 | 4299. | 0. | Static | -7.6 | -7.4 | -7.2 | -7.1 | -6.9 | -7.6 | -7.45 | |
| | | | | Dynamic | 7.4 | 6.7 | 7.1 | 5.4 | 2.2 | 0.5 | 4.54 | 1.15 |
| | | | | Total | -0.2 | -0.7 | -0.1 | -1.7 | -4.7 | -7.1 | -2.91 | |
| 509 | 0.0 | 4280. | 45. | Static | -7.3 | -7.0 | -6.9 | -6.9 | -6.7 | -7.4 | -7.20 | |
| | | | | Dynamic | 7.5 | 6.6 | 6.8 | 6.4 | 6.4 | 6.4 | 6.73 | 1.52 |
| | | | | Total | 0.2 | -0.4 | -0.1 | -0.5 | -0.3 | -1.0 | -0.47 | |
| 489 | 0.0 | 4298. | 90. | Static | -6.8 | -6.5 | -6.6 | -6.3 | -6.3 | -6.9 | -6.73 | |
| | | | | Dynamic | 7.0 | 6.0 | 5.9 | 6.0 | 6.7 | 7.2 | 6.68 | 1.51 |
| | | | | Total | 0.2 | -0.5 | -0.7 | -0.3 | 0.4 | 0.3 | -0.05 | |

TABLE 5.6
(Concluded)

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 516 | 26.5 | 3539. | 0. | Static | -5.1 | -5.6 | -5.4 | -5.3 | -5.2 | -5.4 | -5.40 | |
| | | | | Dynamic | 6.9 | 7.0 | 7.1 | 7.7 | 4.2 | 4.0 | 5.87 | 1.40 |
| | | | | Total | 1.8 | 1.4 | 1.7 | 2.4 | -1.0 | -1.4 | 0.47 | |
| 510 | 26.5 | 3560. | 45. | Static | -5.3 | -5.2 | -5.2 | -5.2 | -5.0 | -5.3 | -5.31 | |
| | | | | Dynamic | 7.9 | 8.6 | 7.9 | 9.2 | 9.3 | 8.3 | 8.45 | 1.70 |
| | | | | Total | 2.6 | 3.4 | 2.7 | 4.0 | 4.3 | 3.0 | 3.14 | |
| 490 | 26.5 | 3541. | 90. | Static | -4.4 | -4.5 | -4.3 | -4.4 | -4.1 | -4.6 | -4.50 | |
| | | | | Dynamic | 8.3 | 8.6 | 7.8 | 8.0 | 8.7 | 8.9 | 8.50 | 1.70 |
| | | | | Total | 3.9 | 4.1 | 3.5 | 3.6 | 4.6 | 4.3 | 4.00 | |
| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
| 517 | 26.5 | 4305. | 0. | Static | -7.4 | -7.6 | -7.3 | -7.5 | -7.3 | -7.8 | -7.61 | |
| | | | | Dynamic | 9.4 | 9.2 | 9.5 | 8.6 | 4.7 | 4.3 | 7.30 | 1.56 |
| | | | | Total | 2.0 | 1.6 | 2.2 | 1.1 | -2.6 | -3.5 | -0.31 | |
| 511 | 26.5 | 4333. | 45. | Static | -7.7 | -7.4 | -7.2 | -7.4 | -7.1 | -7.7 | -7.57 | |
| | | | | Dynamic | 10.5 | 11.1 | 10.0 | 11.0 | 11.4 | 10.3 | 10.66 | 1.91 |
| | | | | Total | 2.8 | 3.7 | 2.8 | 3.6 | 4.3 | 2.6 | 3.09 | |
| 491 | 26.5 | 4348. | 90. | Static | -6.6 | -6.4 | -6.4 | -6.4 | -6.2 | -6.9 | -6.62 | |
| | | | | Dynamic | 10.5 | 10.4 | 9.5 | 10.0 | 11.0 | 11.2 | 10.60 | 1.90 |
| | | | | Total | 3.9 | 4.0 | 3.1 | 3.6 | 4.8 | 4.3 | 3.98 | |
| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
| 518 | 26.5 | 5108. | 0. | Static | -10.4 | -10.2 | -9.9 | -9.9 | -8.9 | -10.3 | -10.13 | |
| | | | | Dynamic | 12.4 | 12.2 | 12.7 | 9.8 | 5.0 | 4.7 | 9.07 | 1.72 |
| | | | | Total | 2.0 | 2.0 | 2.8 | -0.1 | -3.9 | -5.6 | -1.06 | |
| 512 | 26.5 | 5107. | 45. | Static | -10.6 | -9.2 | -9.0 | -9.2 | -8.6 | -9.4 | -9.60 | |
| | | | | Dynamic | 13.4 | 12.9 | 12.0 | 12.6 | 12.7 | 11.7 | 12.58 | 2.07 |
| | | | | Total | 2.8 | 3.7 | 3.0 | 3.4 | 4.1 | 2.3 | 2.98 | |
| 492 | 26.5 | 5095. | 90. | Static | -7.8 | -7.4 | -7.4 | -7.6 | -7.3 | -8.2 | -7.79 | |
| | | | | Dynamic | 11.7 | 11.3 | 10.5 | 11.0 | 12.2 | 12.6 | 11.76 | 2.00 |
| | | | | Total | 3.9 | 3.9 | 3.1 | 3.4 | 4.9 | 4.4 | 3.97 | |

TABLE 5.7

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 519 | 0.0 | 2851. | 0. | Static | -3.1 | -3.2 | -3.2 | -2.9 | -3.0 | -3.4 | -3.26 | |
| | | | | Dynamic | 3.0 | 3.0 | 3.0 | 2.3 | 0.9 | 0.3 | 1.93 | 0.76 |
| | | | | Total | -0.1 | -0.2 | -0.2 | -0.6 | -2.1 | -3.1 | -1.33 | |
| 537 | 0.0 | 2791. | 45. | Static | -3.1 | -3.1 | -3.1 | -3.0 | -2.9 | -3.2 | -3.16 | |
| | | | | Dynamic | 3.1 | 3.2 | 2.8 | 2.7 | 2.4 | 2.3 | 2.74 | 0.97 |
| | | | | Total | 0.0 | 0.1 | -0.3 | -0.3 | -0.5 | -0.9 | -0.42 | |
| 547 | 0.0 | 2820. | 90. | Static | -3.2 | -2.9 | -3.0 | -3.0 | -2.9 | -2.9 | -3.08 | |
| | | | | Dynamic | 3.3 | 3.0 | 2.7 | 3.0 | 3.0 | 3.1 | 3.06 | 1.02 |
| | | | | Total | 0.1 | 0.1 | -0.3 | 0.0 | 0.1 | 0.2 | -0.02 | |

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 520 | 0.0 | 3565. | 0. | Static | -5.0 | -5.1 | -4.9 | -4.9 | -4.7 | -5.4 | -5.13 | |
| | | | | Dynamic | 4.9 | 4.4 | 4.6 | 3.6 | 1.0 | 0.3 | 2.90 | 0.90 |
| | | | | Total | -0.1 | -0.7 | -0.3 | -1.3 | -3.7 | -5.1 | -2.23 | |
| 538 | 0.0 | 3533. | 45. | Static | -5.0 | -5.0 | -5.0 | -4.9 | -4.8 | -5.2 | -5.10 | |
| | | | | Dynamic | 5.1 | 4.8 | 4.5 | 4.5 | 4.2 | 4.0 | 4.52 | 1.24 |
| | | | | Total | 0.1 | -0.2 | -0.5 | -0.4 | -0.6 | -1.2 | -0.58 | |
| 548 | 0.0 | 3554. | 90. | Static | -5.1 | -4.6 | -5.0 | -4.9 | -4.6 | -4.7 | -4.90 | |
| | | | | Dynamic | 5.2 | 4.4 | 4.3 | 4.9 | 4.7 | 4.8 | 4.80 | 1.28 |
| | | | | Total | 0.1 | -0.2 | -0.7 | 0.0 | 0.1 | 0.1 | -0.10 | |

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 521 | 0.0 | 4269. | 0. | Static | -7.2 | -7.4 | -7.2 | -7.1 | -6.8 | -7.3 | -7.26 | |
| | | | | Dynamic | 7.0 | 6.3 | 6.0 | 4.7 | 1.3 | 0.1 | 3.95 | 1.01 |
| | | | | Total | -0.2 | -1.1 | -1.2 | -2.4 | -5.5 | -7.2 | -3.31 | |
| 539 | 0.0 | 4256. | 45. | Static | -6.8 | -6.9 | -7.0 | -6.7 | -6.5 | -7.2 | -6.97 | |
| | | | | Dynamic | 6.9 | 6.4 | 6.2 | 6.1 | 5.9 | 4.7 | 5.98 | 1.43 |
| | | | | Total | 0.1 | -0.5 | -0.8 | -0.6 | -0.6 | -2.5 | -0.99 | |
| 549 | 0.0 | 4266. | 90. | Static | -7.1 | -6.7 | -6.9 | -6.9 | -6.5 | -6.3 | -6.83 | |
| | | | | Dynamic | 7.3 | 6.3 | 6.2 | 6.5 | 6.6 | 6.5 | 6.67 | 1.51 |
| | | | | Total | 0.2 | -0.4 | -0.7 | -0.4 | 0.1 | 0.2 | -0.16 | |

TABLE 5.7
(Concluded)

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 522 | 26.5 | 3568. | 0. | Static | -5.1 | -5.4 | -5.5 | -5.5 | -5.3 | -5.8 | -5.52 | |
| | | | | Dynamic | 6.5 | 6.5 | 7.3 | 6.2 | 2.4 | 2.7 | 4.96 | 1.27 |
| | | | | Total | 1.4 | 1.1 | 1.8 | 0.7 | -2.9 | -3.1 | -0.56 | |
| 540 | 26.5 | 3559. | 45. | Static | -5.0 | -5.2 | -5.4 | -5.6 | -5.4 | -6.3 | -5.61 | |
| | | | | Dynamic | 7.2 | 9.0 | 8.3 | 9.4 | 9.0 | 6.7 | 7.91 | 1.64 |
| | | | | Total | 2.2 | 3.8 | 2.9 | 3.8 | 3.6 | 0.4 | 2.30 | |
| 550 | 26.5 | 3573. | 90. | Static | -5.2 | -5.0 | -5.2 | -5.2 | -5.1 | -4.6 | -5.10 | |
| | | | | Dynamic | 7.8 | 9.6 | 8.9 | 9.0 | 9.9 | 9.4 | 9.00 | 1.75 |
| | | | | Total | 2.6 | 4.6 | 3.7 | 3.8 | 4.8 | 4.8 | 3.90 | |
| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
| 523 | 26.5 | 4382. | 0. | Static | -7.4 | -8.0 | -7.9 | -8.2 | -7.6 | -8.7 | -8.06 | |
| | | | | Dynamic | 9.1 | 8.0 | 9.3 | 7.7 | 2.6 | 2.3 | 6.12 | 1.39 |
| | | | | Total | 1.7 | 0.0 | 1.4 | -0.5 | -5.0 | -6.4 | -1.94 | |
| 541 | 26.5 | 4376. | 45. | Static | -7.3 | -7.8 | -7.7 | -7.9 | -7.4 | -8.4 | -7.87 | |
| | | | | Dynamic | 10.1 | 11.5 | 10.0 | 11.3 | 11.4 | 11.1 | 10.84 | 1.92 |
| | | | | Total | 2.8 | 3.7 | 2.3 | 3.4 | 4.0 | 2.7 | 2.97 | |
| 551 | 26.5 | 4342. | 90. | Static | -7.3 | -7.2 | -7.4 | -7.7 | -7.4 | -6.3 | -7.20 | |
| | | | | Dynamic | 9.9 | 11.6 | 11.1 | 11.5 | 12.4 | 11.1 | 11.10 | 1.95 |
| | | | | Total | 2.6 | 4.4 | 3.7 | 3.8 | 5.0 | 4.8 | 3.90 | |
| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
| 524 | [illegible] | 5105. | 0. | Static | -8.9 | -10.2 | -9.3 | -10.0 | -9.0 | -10.6 | -9.78 | |
| | | | | Dynamic | 10.7 | 10.7 | 10.6 | 10.1 | 2.5 | 2.2 | 7.25 | 1.49 |
| | | | | Total | 1.8 | 0.5 | 1.3 | 0.1 | -6.5 | -8.4 | -2.53 | |
| 542 | 26.5 | 5119. | 45. | Static | -8.9 | -9.1 | -9.0 | -9.9 | -8.6 | -10.0 | -9.35 | |
| | | | | Dynamic | 11.4 | 11.9 | 10.5 | 11.8 | 10.3 | 9.7 | 10.85 | 1.92 |
| | | | | Total | 2.5 | 2.8 | 1.5 | 1.9 | 1.7 | -0.3 | 1.50 | |
| 554 | 26.5 | 4932. | 90. | Static | -8.6 | -8.5 | -8.5 | -9.1 | -8.5 | -7.3 | -8.39 | |
| | | | | Dynamic | 11.1 | 12.6 | 11.9 | 12.9 | 13.7 | 11.7 | 12.12 | 2.03 |
| | | | | Total | 2.5 | 4.1 | 3.4 | 3.8 | 5.2 | 4.4 | 3.73 | |

TABLE 5.8

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 525 | 0.0 | 2811. | 0. | Static | -3.2 | -3.2 | -3.1 | -3.2 | -3.0 | -3.3 | -3.26 | |
| | | | | Dynamic | 3.1 | 3.1 | 3.1 | 2.6 | 0.8 | 0.1 | 1.95 | 0.73 |
| | | | | Total | -0.1 | -0.1 | -0.0 | -0.6 | -2.2 | -3.2 | -1.31 | |
| 531 | 0.0 | 2820. | 45. | Static | -3.2 | -3.1 | -3.1 | -3.2 | -3.0 | -3.4 | -3.27 | |
| | | | | Dynamic | 3.2 | 3.2 | 3.0 | 2.9 | 2.7 | 2.3 | 2.86 | 0.99 |
| | | | | Total | 0.0 | 0.1 | -0.1 | -0.3 | -0.3 | -1.1 | -0.41 | |
| 555 | 0.0 | 2802. | 90. | Static | -3.2 | -3.0 | -3.1 | -3.0 | -2.9 | -3.1 | -3.15 | |
| | | | | Dynamic | 3.3 | 3.1 | 2.7 | 2.9 | 3.0 | 3.3 | 3.13 | 1.03 |
| | | | | Total | 0.1 | 0.1 | -0.4 | -0.1 | 0.1 | 0.2 | -0.02 | |

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 526 | 0.0 | 3558. | 0. | Static | -5.2 | -5.1 | -5.1 | -5.0 | -4.8 | -5.2 | -5.18 | |
| | | | | Dynamic | 5.2 | 4.6 | 4.8 | 3.8 | 1.2 | 0.1 | 3.05 | 0.91 |
| | | | | Total | 0.0 | -0.5 | -0.3 | -1.2 | -3.6 | -5.1 | -2.13 | |
| 532 | 0.0 | 3582. | 45. | Static | -5.1 | -5.2 | -5.1 | -5.0 | -4.8 | -5.4 | -5.24 | |
| | | | | Dynamic | 5.2 | 4.9 | 4.8 | 4.5 | 4.2 | 3.0 | 4.34 | 1.21 |
| | | | | Total | 0.1 | -0.3 | -0.3 | -0.5 | -0.6 | -2.4 | -0.90 | |
| 556 | 0.0 | 3550. | 90. | Static | -5.1 | -4.8 | -5.0 | -5.1 | -4.8 | -4.7 | -5.00 | |
| | | | | Dynamic | 5.3 | 4.6 | 4.5 | 4.9 | 4.9 | 5.0 | 4.94 | 1.30 |
| | | | | Total | 0.2 | -0.2 | -0.5 | -0.3 | 0.1 | 0.3 | -0.06 | |

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 527 | 0.0 | 4270. | 0. | Static | -7.3 | -7.4 | -7.2 | -7.1 | -6.7 | -7.2 | -7.27 | |
| | | | | Dynamic | 7.2 | 6.4 | 6.4 | 4.9 | 1.3 | -0.1 | 4.03 | 0.98 |
| | | | | Total | -0.1 | -1.0 | -0.8 | -2.2 | -5.4 | -7.3 | -3.24 | |
| 533 | 0.0 | 4201. | 45. | Static | -7.0 | -6.9 | -6.8 | -6.6 | -6.4 | -7.1 | -6.96 | |
| | | | | Dynamic | 7.2 | 6.3 | 6.5 | 6.1 | 5.9 | 3.7 | 5.83 | 1.40 |
| | | | | Total | 0.2 | -0.6 | -0.3 | -0.5 | -0.5 | -3.4 | -1.13 | |
| 557 | 0.0 | 4242. | 90. | Static | -7.0 | -6.7 | -6.8 | -6.9 | -6.7 | -6.5 | -6.85 | |
| | | | | Dynamic | 7.2 | 6.2 | 6.3 | 6.5 | 7.0 | 6.9 | 6.82 | 1.52 |
| | | | | Total | 0.2 | -0.5 | -0.5 | -0.4 | 0.3 | 0.4 | -0.03 | |

TABLE 5.8
(Concluded)

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 528 | 26.5 | 3582. | 0. | Static | -5.4 | -5.8 | -5.7 | -5.6 | -5.4 | -6.0 | -5.73 | |
| | | | | Dynamic | 7.0 | 7.1 | 7.8 | 6.7 | 2.8 | 2.0 | 5.16 | 1.28 |
| | | | | Total | 1.6 | 1.3 | 2.1 | 1.1 | -2.6 | -4.0 | -0.57 | |
| 534 | 26.5 | 3539. | 45. | Static | -5.1 | -5.1 | -5.2 | -5.3 | -5.0 | -5.6 | -5.34 | |
| | | | | Dynamic | 7.1 | 8.7 | 8.4 | 8.8 | 8.7 | 6.4 | 7.69 | 1.62 |
| | | | | Total | 2.0 | 3.4 | 3.2 | 3.5 | 3.7 | 0.8 | 2.35 | |
| 560 | 26.5 | 3545. | 90. | Static | -5.4 | -5.0 | -5.2 | -5.2 | -5.1 | -4.9 | -5.20 | |
| | | | | Dynamic | 7.8 | 9.4 | 9.3 | 9.3 | 9.7 | 9.3 | 8.99 | 1.75 |
| | | | | Total | 2.4 | 4.4 | 4.1 | 4.1 | 4.6 | 4.4 | 3.79 | |
| 560 | 26.5 | 3545. | 90. | Static | -5.4 | -5.0 | -5.2 | -5.2 | -5.1 | -4.9 | -5.20 | |
| | | | | Dynamic | 7.8 | 9.4 | 9.3 | 9.3 | 9.7 | 9.3 | 8.99 | 1.75 |
| | | | | Total | 2.4 | 4.4 | 4.1 | 4.1 | 4.6 | 4.4 | 3.79 | |

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 529 | 26.5 | 4352. | 0. | Static | -7.5 | -8.3 | -7.9 | -7.9 | -7.6 | -8.5 | -8.04 | |
| | | | | Dynamic | 9.4 | 8.8 | 9.7 | 8.0 | 3.7 | 1.9 | 6.44 | 1.42 |
| | | | | Total | 1.9 | 0.5 | 1.8 | 0.1 | -3.9 | -6.6 | -1.60 | |
| 535 | 26.5 | 4313. | 45. | Static | -7.4 | -7.5 | -7.5 | -7.5 | -7.2 | -8.1 | -7.68 | |
| | | | | Dynamic | 10.0 | 11.3 | 10.1 | 10.7 | 10.9 | 8.3 | 9.96 | 1.84 |
| | | | | Total | 2.6 | 3.8 | 2.6 | 3.2 | 3.7 | 0.2 | 2.28 | |
| 561 | 26.5 | 4382. | 90. | Static | -7.8 | -7.4 | -7.5 | -7.7 | -7.3 | -6.9 | -7.48 | |
| | | | | Dynamic | 10.1 | 11.8 | 11.3 | 11.6 | 12.3 | 11.4 | 11.29 | 1.95 |
| | | | | Total | 2.3 | 4.4 | 3.8 | 3.9 | 5.0 | 4.5 | 3.81 | |

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 530 | 26.5 | 5106. | 0. | Static | -9.6 | -9.9 | -9.3 | -9.9 | -9.0 | -10.4 | -9.85 | |
| | | | | Dynamic | 11.3 | 10.7 | 11.5 | 10.1 | 3.5 | 1.9 | 7.54 | 1.52 |
| | | | | Total | 1.7 | 0.8 | 2.2 | 0.2 | -5.5 | -8.5 | -2.31 | |
| 536 | 26.5 | 5114. | 45. | Static | -9.1 | -9.3 | -9.2 | -9.3 | -8.7 | -9.9 | -9.36 | |
| | | | | Dynamic | 11.5 | 12.7 | 11.0 | 12.1 | 11.4 | 6.2 | 10.33 | 1.86 |
| | | | | Total | 2.4 | 3.4 | 1.8 | 2.8 | 2.7 | -3.7 | 0.97 | |
| 562 | 26.5 | 5060. | 90. | Static | -9.8 | -9.1 | -8.7 | -9.4 | -9.7 | -7.5 | -9.04 | |
| | | | | Dynamic | 12.0 | 13.3 | 12.0 | 13.4 | 14.9 | 12.0 | 12.77 | 2.09 |
| | | | | Total | 2.2 | 4.2 | 3.3 | 4.0 | 5.2 | 4.5 | 3.73 | |

## TABLE 6.1

Static Pressures, Stevens Inlet, 8 inch Transition

| Run No | Model Vel fps | Impeller Speed rpm | I1 | I2 | I3 | I4 | T1 | T2 | T3 | $H_p$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 337# | 0.00 | 2175 | -0.1 | -0.1 | -0.5 | -0.8 | -1.8 | -1.8 | -1.5 | 5.8 |
| 372# | 0.00 | 2182 | -0.5 | -0.2 | -0.9 | -0.8 | -1.8 | -1.8 | -1.7 | 4.2 |
| 329# | 0.00 | 2172 | -0.1 | -0.2 | -0.5 | -0.7 | -1.7 | -1.7 | -1.6 | 5.8 |
| 338# | 0.00 | 2808 | -0.2 | -0.3 | -1.0 | -1.3 | -3.1 | -3.1 | -2.5 | 27.2 |
| 373# | 0.00 | 2819 | -0.5 | -0.3 | -1.3 | -1.2 | -3.0 | -3.1 | -2.8 | 6.1 |
| 325# | 0.00 | 2808 | -0.2 | -0.2 | -1.1 | -1.2 | -2.9 | -3.0 | -2.8 | 15.6 |
| 339# | 0.00 | 3528 | -0.3 | -0.5 | -1.4 | -1.9 | -4.7 | -4.8 | -4.3 | 23.1 |
| 374# | 0.00 | 3598 | -0.7 | -0.6 | -1.9 | -2.0 | -4.8 | -5.0 | -4.4 | 8.8 |
| 327# | 0.00 | 3563 | -0.3 | -0.4 | -1.4 | -1.9 | -4.5 | -4.8 | -4.3 | 9.3 |
| 341 | 26.50 | 3528 | -0.1 | -1.2 | -0.2 | -0.3 | -5.1 | -4.6 | -3.4 | 4.0 |
| 369 | 26.50 | 3561 | 0.4 | -1.0 | 0.4 | -0.1 | -4.9 | -4.4 | -3.2 | 4.7 |
| 322 | 26.50 | 3575 | 0.3 | -1.1 | 0.5 | -0.2 | -5.0 | -4.3 | -3.4 | 4.6 |
| 342 | 26.50 | 4320 | -0.6 | -1.6 | -0.2 | -1.0 | -7.2 | -6.5 | -5.1 | 8.9 |
| 370 | 26.50 | 4357 | 0.3 | -1.5 | 0.1 | -0.8 | -7.9 | -6.9 | -5.3 | 9.6 |
| 324 | 26.50 | 4289 | 0.1 | -1.5 | 0.0 | -0.9 | -7.4 | -6.6 | -5.2 | 8.5 |
| 343 | 26.50 | 4869 | -0.7 | -1.7 | -0.3 | -1.1 | -8.3 | -7.9 | -6.0 | 12.0 |
| 371 | 26.50 | 5130 | 0.3 | -1.8 | -0.2 | -1.3 | -11.0 | -9.4 | -7.3 | 14.7 |
| 323 | 26.50 | 5068 | 0.1 | -1.8 | -0.3 | -1.3 | -10.0 | -8.5 | -6.4 | 15.1 |

## TABLE 6.2

Static Pressures, 21/2.50 Inlet, 6 inch Transition

| Run No | Model Vel fps | Impeller Speed rpm | I1 | I2 | I3 | I4 | T1 | T2 | T3 | $H_p$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 405 | 0.00 | 2826 | -0.3 | -1.0 | -1.3 | -1.6 | -3.2 | -2.4 | -2.3 | 7.0 |
| 377# | 0.00 | 2826 | -0.3 | -0.7 | -1.1 | -1.1 | -3.1 | -2.6 | -2.9 | 6.8 |
| 446 | 0.00 | 2798 | -0.4 | -0.9 | -1.2 | -1.3 | -2.6 | -2.3 | -2.1 | 7.2 |
| 406 | 0.00 | 3532 | -0.5 | -1.5 | -1.9 | -2.5 | -5.2 | -3.8 | -3.8 | 8.0 |
| 376# | 0.00 | 3535 | -0.5 | -1.1 | -1.7 | -1.8 | -4.8 | -4.2 | -4.3 | 10.1 |
| 447 | 0.00 | 3523 | -0.6 | -1.3 | -1.9 | -2.2 | -4.4 | -3.7 | -3.4 | 9.9 |
| 407 | 0.00 | 4218 | -0.7 | -2.0 | -2.5 | -3.3 | -6.9 | -5.4 | -5.3 | 13.3 |
| 378# | 0.00 | 4296 | -0.7 | -1.5 | -2.5 | -2.6 | -6.7 | -6.0 | -6.4 | 12.9 |
| 448 | 0.00 | 4262 | -0.8 | -1.8 | -2.6 | -3.0 | -5.4 | -4.9 | -4.7 | 12.3 |
| 409 | 26.50 | 3550 | 0.4 | -4.5 | -1.5 | -2.8 | -4.3 | -2.9 | -2.4 | 4.6 |
| 379 | 26.50 | 3583 | 1.0 | -5.0 | -0.9 | -2.8 | -3.9 | -2.9 | -3.3 | 5.2 |
| 450 | 26.50 | 3597 | -0.1 | -3.6 | -2.8 | -2.8 | -3.5 | -2.7 | -1.4 | 5.3 |
| 410 | 26.50 | 4343 | -0.2 | -5.7 | -2.3 | -4.0 | -6.0 | -4.5 | -3.7 | 7.3 |
| 380 | 26.50 | 4321 | 0.8 | -6.5 | -2.1 | -3.9 | -5.5 | -4.5 | -5.3 | 9.4 |
| 451 | 26.50 | 4339 | -0.7 | -5.3 | -2.2 | -2.7 | -5.1 | -4.1 | -3.4 | 8.1 |
| 411* | 26.50 | 3507 | -3.1 | -4.2 | -3.8 | -4.1 | -4.1 | -4.9 | -4.3 | 10.4 |
| 381 | 26.50 | 5045 | 0.7 | -6.3 | -2.5 | -4.6 | -7.4 | -5.5 | -5.0 | 15.3 |
| 453 | 26.50 | 5085 | -0.9 | -6.1 | -2.5 | -3.9 | -6.3 | -5.0 | -4.0 | 14.0 |

#No bollard fairing attached at the inlet
*Run is no good

TABLE 6.3

Static Pressures, 21/2.50 Inlet, 8 inch Transition

| Run No | Model Vel fps | Impeller Speed rpm | I1 | I2 | I3 | I4 | T1 | T2 | T3 | $H_p$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 416 | 0.00 | 2790 | -0.4 | -1.0 | -1.4 | -1.6 | -3.1 | -2.7 | -2.1 | 4.6 |
| 438 | 0.00 | 2816 | -0.3 | -1.1 | -1.2 | -1.7 | -3.4 | -3.0 | -2.1 | 5.8 |
| 455 | 0.00 | 2822 | -0.4 | -0.8 | -1.3 | -1.4 | -2.7 | -2.3 | -1.9 | 7.0 |
| 417 | 0.00 | 3550 | -0.7 | -1.7 | -2.0 | -2.6 | -5.0 | -4.5 | -3.3 | 8.6 |
| 439 | 0.00 | 3588 | -0.5 | -1.9 | -1.9 | -2.7 | -5.5 | -4.9 | -3.3 | 8.8 |
| 456 | 0.00 | 3560 | -0.5 | -1.4 | -1.9 | -2.4 | -4.7 | -3.9 | -3.1 | 10.6 |
| 418 | 0.00 | 4255 | -1.0 | -2.3 | -2.9 | -3.6 | -7.5 | -6.6 | -4.6 | 12.2 |
| 440 | 0.00 | 4296 | -0.7 | -2.5 | -2.6 | -3.5 | -6.9 | -6.2 | -4.4 | 12.4 |
| 457 | 0.00 | 4271 | -0.9 | -1.8 | -2.7 | -3.2 | -6.3 | -5.5 | -4.1 | 13.9 |
| 422 | 26.50 | 3568 | 0.2 | 3.2 | -1.5 | -2.2 | -4.0 | -3.7 | -1.6 | 4.1 |
| 442 | 26.50 | 3583 | 0.3 | -4.3 | -2.9 | -3.5 | -4.0 | -3.7 | -1.4 | 3.5 |
| 458 | 26.50 | 3658 | -0.1 | -3.9 | -1.5 | -1.7 | -3.5 | -3.2 | -1.3 | 5.4 |
| 423 | 26.50 | 4367 | -0.7 | 1.0 | -2.6 | -3.8 | -5.6 | -5.5 | -2.5 | 7.9 |
| 444 | 26.50 | 4331 | -0.3 | -5.9 | -2.3 | -3.9 | -5.8 | -5.2 | -2.7 | 6.9 |
| 459 | 26.50 | 4333 | -0.7 | -5.1 | -2.2 | -3.2 | -4.9 | -4.5 | -2.2 | 9.3 |
| 425 | 26.50 | 5106 | -1.2 | 0.1 | -3.5 | -4.9 | -8.1 | -7.1 | -3.7 | 12.9 |
| 445 | 26.50 | 5169 | -0.7 | -6.9 | -3.1 | -5.1 | -8.3 | -7.1 | -3.7 | 14.0 |
| 460* | 26.50 | 3987 | -1.3 | -4.1 | -2.0 | -3.1 | -4.8 | -4.3 | -2.4 | 12.0 |

TABLE 6.4

Static Pressures, 21/2.50 Inlet, 10 inch Transition

| Run No | Model Vel fps | Impeller Speed rpm | I1 | I2 | I3 | I4 | T1 | T2 | T3 | $H_p$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 402 | 0.00 | 2796 | -0.3 | -0.9 | -1.4 | -1.7 | -3.6 | -2.8 | -1.9 | 4.7 |
| 389 | 0.00 | 2876 | -0.1 | -1.1 | -1.4 | -1.4 | -3.2 | -2.7 | -2.0 | 5.0 |
| 465 | 0.00 | 2817 | -0.4 | -0.9 | -1.4 | -1.4 | -3.0 | -2.2 | -1.7 | 6.4 |
| 403 | 0.00 | 3528 | -0.5 | -1.3 | -2.0 | -2.5 | -5.7 | -4.5 | -2.9 | 8.1 |
| 390 | 0.00 | 3550 | -0.4 | -1.6 | -2.0 | -2.2 | -4.7 | -4.0 | -2.9 | 8.2 |
| 466 | 0.00 | 3560 | -0.6 | -1.5 | -2.1 | -2.4 | -5.0 | -3.7 | -2.8 | 10.4 |
| 404 | 0.00 | 4280 | -0.7 | -1.8 | -2.7 | -3.6 | -8.1 | -6.4 | -4.2 | 12.4 |
| 391 | 0.00 | 4312 | -0.5 | -2.1 | -2.8 | -3.2 | -7.2 | -5.6 | -4.0 | 12.1 |
| 467 | 0.00 | 4271 | -0.8 | -2.1 | -2.8 | -3.1 | -6.8 | -5.1 | -3.8 | 13.3 |
| 399 | 26.50 | 3567 | 0.3 | -4.7 | -1.5 | -2.3 | -4.1 | -3.2 | -0.9 | 3.3 |
| 394 | 26.50 | 3566 | 0.8 | -4.4 | -1.5 | -2.1 | -3.9 | -2.9 | -0.8 | 3.6 |
| 468 | 26.50 | 3579 | 0.3 | -4.2 | -1.1 | -1.9 | -3.3 | -2.4 | -0.7 | 6.3 |
| 400 | 26.50 | 4318 | -0.4 | -5.4 | -2.6 | -4.3 | -5.8 | -4.7 | -1.9 | 7.5 |
| 395 | 26.50 | 4354 | -0.5 | -5.7 | -2.4 | -3.8 | -5.7 | -4.7 | -2.1 | 7.8 |
| 470 | 26.50 | 4352 | -0.4 | -5.2 | -2.0 | -3.3 | -4.8 | -3.9 | -1.6 | 9.9 |
| 401 | 26.50 | 5102 | -0.5 | -6.2 | -2.9 | -4.8 | -7.9 | -6.1 | -2.6 | 13.7 |
| 397 | 26.50 | 5148 | -0.6 | -6.4 | -3.0 | -4.5 | -7.8 | -6.0 | -2.7 | 13.4 |
| 472 | 26.50 | 5033 | -1.2 | -6.2 | -2.7 | -4.0 | -5.8 | -4.9 | -2.2 | 14.8 |

*Run is no good

TABLE 6.5

Static Pressures, 27/0 Inlet, 6 inch Transition

| Run No | Model Vel fps | Impeller Speed rpm | I1 | I2 | I3 | I4 | T1 | T2 | T3 | $H_p$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 493 | 0.00 | 2799 | -0.3 | -0.5 | -1.4 | -1.5 | -3.1 | -2.7 | -3.0 | 8.1 |
| 501 | 0.00 | 2816 | -0.4 | -0.5 | -1.5 | -1.5 | -3.3 | -2.9 | -3.0 | 8.5 |
| 476 | 0.00 | 2810 | -0.3 | -0.4 | -1.4 | -1.3 | -2.8 | -2.3 | -2.5 | 8.2 |
| 495 | 0.00 | 3542 | -0.4 | -0.7 | -2.4 | -2.5 | -5.2 | -4.5 | -4.8 | 12.2 |
| 502 | 0.00 | 3579 | -0.6 | -0.8 | -2.2 | -2.4 | -5.1 | -4.5 | -4.7 | 14.6 |
| 477 | 0.00 | 3552 | -0.5 | -0.6 | -2.1 | -2.2 | -4.7 | -3.9 | -4.3 | 12.4 |
| 496 | 0.00 | 4296 | -0.6 | -1.0 | -3.3 | -3.5 | -7.5 | -6.4 | -6.7 | 16.5 |
| 503 | 0.00 | 4291 | -0.8 | -1.1 | -3.1 | -3.4 | -7.3 | -6.2 | -6.4 | 19.2 |
| 478 | 0.00 | 4288 | -0.6 | -0.9 | -2.7 | -3.1 | -6.7 | -5.6 | -5.8 | 17.1 |
| 497 | 26.50 | 3574 | 0.0 | -3.3 | -0.4 | -0.4 | -3.5 | -3.5 | -2.8 | 1.2 |
| 504 | 26.50 | 3596 | 0.0 | -3.3 | -0.6 | -0.4 | -3.3 | -3.5 | -2.7 | 3.2 |
| 480 | 26.50 | 3528 | -0.3 | -2.7 | -0.6 | -0.4 | -2.9 | -2.5 | -2.1 | 4.7 |
| 498 | 26.50 | 4340 | -0.3 | -4.1 | -1.3 | -1.4 | -5.1 | -5.1 | -4.7 | 5.4 |
| 505 | 26.50 | 4384 | -0.5 | -4.1 | -1.3 | -1.1 | -5.2 | -5.1 | -4.5 | 6.8 |
| 481 | 26.50 | 4373 | -1.0 | -3.5 | -1.7 | -1.1 | -4.5 | -4.1 | -3.7 | 10.3 |
| 499 | 26.50 | 5099 | -0.6 | -4.7 | -2.1 | -2.0 | -6.6 | -6.5 | -6.5 | 11.8 |
| 506 | 26.50 | 5132 | -0.7 | -4.5 | -2.1 | -1.9 | -6.4 | -6.5 | -6.1 | 12.9 |
| 485 | 26.50 | 5103 | -1.3 | -3.7 | -2.1 | -1.6 | -5.2 | -4.9 | -4.7 | 15.3 |

TABLE 6.6

Static Pressures, 27/0 Inlet, 10 inch Transition

| Run No | Model Vel fps | Impeller Speed rpm | I1 | I2 | I3 | I4 | T1 | T2 | T3 | $H_p$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 513 | 0.00 | 2827 | -0.4 | -0.5 | -1.6 | -1.5 | -3.5 | -2.8 | -2.2 | 8.9 |
| 507 | 0.00 | 2849 | -0.4 | -0.5 | -1.6 | -1.6 | -3.6 | -2.8 | -2.1 | 9.0 |
| 487 | 0.00 | 2799 | -0.3 | -0.3 | -1.4 | -1.3 | -3.3 | -2.7 | -2.0 | 8.2 |
| 514 | 0.00 | 3594 | -0.6 | -0.7 | -2.5 | -2.6 | -5.5 | -4.4 | -3.4 | 13.9 |
| 508 | 0.00 | 3587 | -0.6 | -0.8 | -2.5 | -2.5 | -5.5 | -4.3 | -3.2 | 14.0 |
| 488 | 0.00 | 3578 | -0.6 | -0.5 | -2.2 | -2.2 | -5.4 | -4.5 | -3.3 | 13.3 |
| 515 | 0.00 | 4299 | -0.8 | -1.0 | -3.3 | -3.5 | -8.1 | -6.3 | -4.7 | 18.5 |
| 509 | 0.00 | 4280 | -0.8 | -1.0 | -3.2 | -3.4 | -7.7 | -6.0 | -4.4 | 18.4 |
| 489 | 0.00 | 4298 | -0.7 | -0.8 | -2.9 | -3.1 | -7.4 | -6.2 | -4.5 | 17.8 |
| 516 | 26.50 | 3539 | -0.1 | -3.1 | -1.1 | -0.6 | -3.6 | -2.9 | -1.1 | 3.2 |
| 510 | 26.50 | 3560 | 0.1 | -3.2 | -0.8 | -0.5 | -3.5 | -2.9 | -1.1 | 2.5 |
| 490 | 26.50 | 3541 | 0.0 | -2.7 | -0.8 | -0.3 | -3.1 | -2.7 | -0.7 | 2.3 |
| 517 | 26.50 | 4305 | -0.6 | -3.9 | -1.7 | -1.3 | -5.1 | -4.5 | -2.4 | 8.5 |
| 511 | 26.50 | 4333 | -0.6 | -4.0 | -1.7 | -1.3 | -5.2 | -4.4 | -2.2 | 7.4 |
| 491 | 26.50 | 4348 | -0.5 | -3.5 | -1.4 | -1.1 | -4.7 | -4.3 | -2.0 | 6.9 |
| 518 | 26.50 | 5108 | -1.0 | -4.7 | -2.2 | -2.0 | -7.0 | -6.1 | -3.6 | 14.6 |
| 512 | 26.50 | 5107 | -0.8 | -4.4 | -2.2 | -1.8 | -6.8 | -5.6 | -3.2 | 14.2 |
| 492 | 26.50 | 5095 | -0.6 | -3.8 | -1.7 | -1.5 | -5.4 | -5.1 | -2.6 | 12.8 |

TABLE 6.7

Static Pressures, 21/0 Inlet 6 inch Transition

| Run No | Model Vel fps | Impeller Speed rpm | I1 | I2 | I3 | I4 | T1 | T2 | T3 | $H_p$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 519 | 0.00 | 2851 | -0.3 | -0.9 | -1.5 | -1.6 | -3.5 | -2.7 | -2.5 | 8.7 |
| 537 | 0.00 | 2791 | -0.2 | -0.8 | -1.5 | -1.6 | -3.7 | -2.8 | -2.6 | 7.8 |
| 547 | 0.00 | 2820 | 0.2 | -0.9 | -1.3 | -1.6 | -3.5 | -2.6 | -2.6 | 6.2 |
| 520 | 0.00 | 3565 | -0.5 | -1.4 | -2.4 | -2.7 | -5.6 | -4.3 | -4.1 | 13.4 |
| 538 | 0.00 | 3533 | -0.4 | -1.4 | -2.5 | -2.7 | -5.8 | -4.6 | -4.1 | 11.2 |
| 548 | 0.00 | 3554 | 0.2 | -1.4 | -2.2 | -2.6 | -5.8 | -4.3 | -4.2 | 10.3 |
| 521 | 0.00 | 4269 | -0.5 | -2.0 | -3.2 | -3.6 | -8.4 | -6.4 | -5.9 | 16.6 |
| 539 | 0.00 | 4256 | -0.6 | -2.0 | -3.3 | -3.7 | -7.9 | -6.3 | -5.5 | 15.3 |
| 549 | 0.00 | 4266 | 0.2 | -2.0 | -3.0 | -3.6 | -8.2 | -6.1 | -5.9 | 13.3 |
| 522 | 26.50 | 3568 | -0.1 | -4.8 | -2.0 | -2.6 | -4.5 | -3.5 | -2.3 | 5.7 |
| 540 | 26.50 | 3559 | -0.1 | -5.2 | -2.3 | -2.9 | -4.7 | -4.0 | -2.3 | 5.6 |
| 550 | 26.50 | 3573 | 0.2 | -5.0 | -1.9 | -2.5 | -4.5 | -3.3 | -1.8 | 5.3 |
| 523 | 26.50 | 4382 | -0.6 | -6.5 | -2.6 | -3.9 | -7.0 | -5.4 | -3.8 | 11.0 |
| 541 | 26.50 | 4376 | -0.7 | -6.5 | -2.7 | -3.9 | -6.9 | -5.4 | -3.7 | 10.6 |
| 551 | 26.50 | 4342 | 0.2 | -6.4 | -2.6 | -4.1 | -7.3 | -5.1 | -3.7 | 10.1 |
| 524 | 26.50 | 5105 | -1.0 | -7.1 | -3.3 | -4.9 | -9.1 | -6.9 | -5.1 | 17.8 |
| 542 | 26.50 | 5119 | -1.2 | -7.1 | -3.4 | -4.7 | -8.2 | -6.8 | -4.7 | 17.8 |
| 554 | 26.50 | 4932 | 0.2 | -6.9 | -3.2 | -4.9 | -8.2 | -6.2 | -4.6 | 14.7 |

TABLE 6.8

Static Pressures, 27/0 Inlet, 10 inch Transition

| Run No | Model Vel fps | Impeller Speed rpm | I1 | I2 | I3 | I4 | T1 | T2 | T3 | $H_p$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 525 | 0.00 | 2811 | -0.3 | -0.8 | -1.6 | -1.7 | -3.8 | -2.8 | -2.0 | 7.8 |
| 531 | 0.00 | 2820 | -0.3 | -0.8 | -1.7 | -1.7 | -4.0 | -2.8 | -2.1 | 7.9 |
| 555 | 0.00 | 2802 | 0.2 | -0.9 | -1.6 | -1.7 | -3.8 | -2.8 | -2.0 | 9.6 |
| 526 | 0.00 | 3558 | -0.4 | -1.4 | -2.5 | -2.7 | -6.1 | -4.5 | -3.2 | 11.5 |
| 532 | 0.00 | 3582 | -0.5 | -1.4 | -2.6 | -2.8 | -6.3 | -4.5 | -3.3 | 12.1 |
| 556 | 0.00 | 3550 | 0.2 | -1.5 | -2.5 | -2.7 | -6.1 | -4.5 | -3.1 | 15.4 |
| 527 | 0.00 | 4270 | -0.6 | -2.0 | -3.4 | -3.7 | -8.9 | -6.5 | -4.6 | 15.3 |
| 533 | 0.00 | 4201 | -0.6 | -1.9 | -3.3 | -3.7 | -8.2 | -6.0 | -4.3 | 15.8 |
| 557 | 0.00 | 4242 | 0.2 | -2.1 | -3.4 | -3.7 | -8.3 | -6.1 | -4.2 | 20.5 |
| 528 | 26.50 | 3582 | -0.1 | -5.0 | -2.1 | -3.1 | -5.6 | -3.3 | -1.0 | 6.1 |
| 534 | 26.50 | 3539 | -0.1 | -4.8 | -2.1 | -2.4 | -5.6 | -3.3 | -1.1 | 5.2 |
| 560 | 26.50 | 3545 | 0.2 | -5.1 | -1.9 | -2.5 | -5.5 | -3.3 | -1.1 | 5.7 |
| 529 | 26.50 | 4352 | -0.6 | -6.4 | -2.7 | -4.2 | -7.7 | -5.0 | -2.1 | 10.3 |
| 535 | 26.50 | 4313 | -0.6 | -6.3 | -2.7 | -4.1 | -7.5 | -4.7 | -2.0 | 10.2 |
| 561 | 26.50 | 4382 | 0.2 | -6.6 | -2.9 | -4.5 | -8.1 | -5.2 | -2.5 | 11.6 |
| 530 | 26.50 | 5106 | -0.9 | -7.1 | -3.7 | -5.5 | -10.6 | -6.8 | -3.3 | 17.3 |
| 536 | 26.50 | 5114 | -0.9 | -6.9 | -3.4 | -4.8 | -9.7 | -6.3 | -3.0 | 17.7 |
| 562 | 26.50 | 5060 | 0.2 | -7.4 | -3.2 | -4.9 | -9.6 | -6.5 | -3.0 | 16.4 |

TABLE 7.1

Lift and Drag Characteristics
Stevens Inlet, 8 inch Transition

Hull Drag = 144.0 Hull Lift = 334.0

| Run | Vel | RPM | Drag | $D_i$ | $C_{Di}$ | Lift | $L_i$ | $C_{Li}$ | IVR |
|---|---|---|---|---|---|---|---|---|---|
| 337 | 0.0 | 2175 | 0.3 | 0.3 | 0.00 | -2.4 | -2.4 | 0.00 | 0.00 |
| 372 | 0.0 | 2182 | -0.2 | -0.2 | 0.00 | -7.1 | -7.1 | 0.00 | 0.00 |
| 329 | 0.0 | 2172 | 0.0 | 0.0 | 0.00 | -2.6 | -2.6 | 0.00 | 0.00 |
| 338 | 0.0 | 2808 | 0.1 | 0.1 | 0.00 | 1.0 | 1.0 | 0.00 | 0.00 |
| 373 | 0.0 | 2819 | -0.4 | -0.4 | 0.00 | -0.6 | -0.6 | 0.00 | 0.00 |
| 325 | 0.0 | 2808 | 0.0 | 0.0 | 0.00 | 27.7 | 27.7 | 0.00 | 0.00 |
| 339 | 0.0 | 3528 | 0.0 | 0.0 | 0.00 | -4.9 | -4.9 | 0.00 | 0.00 |
| 374 | 0.0 | 3598 | -0.6 | -0.6 | 0.00 | -4.9 | -4.9 | 0.00 | 0.00 |
| 327 | 0.0 | 3563 | 0.0 | 0.0 | 0.00 | 1.6 | 1.6 | 0.00 | 0.00 |
| 341 | 26.5 | 3528 | 227.2 | 1.6 | 0.02 | 295.2 | -38.8 | -0.52 | 0.92 |
| 369 | 26.5 | 3561 | 228.1 | 2.5 | 0.03 | 299.5 | -34.5 | -0.46 | 0.92 |
| 322 | 26.5 | 3575 | 236.8 | 11.2 | 0.15 | 284.9 | -49.1 | -0.66 | 0.92 |
| 342 | 26.5 | 4320 | 234.5 | -1.3 | -0.02 | 302.0 | -32.0 | -0.43 | 1.03 |
| 370 | 26.5 | 4357 | 236.4 | 0.6 | 0.01 | 297.4 | -36.6 | -0.49 | 1.03 |
| 324 | 26.5 | 4289 | 240.1 | 4.3 | 0.06 | 291.0 | -43.0 | -0.58 | 1.03 |
| 343 | 26.5 | 4869 | 236.2 | -6.3 | -0.08 | 287.3 | -46.7 | -0.63 | 1.11 |
| 371 | 26.5 | 5130 | 240.5 | -2.0 | -0.03 | 287.3 | -46.7 | -0.63 | 1.11 |
| 323 | 26.5 | 5068 | 242.4 | -0.1 | 0.00 | 285.5 | -48.5 | -0.65 | 1.11 |

TABLE 7.2

Lift and Drag Characteristics
21/2.5 Inlet, 6 inch Transition

Hull Drag = 152.0 Hull Lift = 358.0

| Run | Vel | RPM | Drag | $D_i$ | $C_{Di}$ | Lift | $L_i$ | $C_{Li}$ | IVR |
|---|---|---|---|---|---|---|---|---|---|
| 405 | 0.0 | 2826 | -0.1 | -0.1 | 0.00 | -5.0 | -5.0 | 0.00 | 0.00 |
| 377 | 0.0 | 2826 | -0.2 | -0.2 | 0.00 | 0.2 | 0.2 | 0.00 | 0.00 |
| 446 | 0.0 | 2798 | 0.1 | 0.1 | 0.00 | -1.9 | -1.9 | 0.00 | 0.00 |
| 406 | 0.0 | 3532 | 0.4 | 0.4 | 0.00 | -1.8 | -1.8 | 0.00 | 0.00 |
| 376 | 0.0 | 3535 | 0.3 | 0.3 | 0.00 | -2.2 | -2.2 | 0.00 | 0.00 |
| 447 | 0.0 | 3523 | 0.6 | 0.6 | 0.00 | -3.2 | -3.2 | 0.00 | 0.00 |
| 407 | 0.0 | 4218 | 0.5 | 0.5 | 0.00 | -3.0 | -3.0 | 0.00 | 0.00 |
| 378 | 0.0 | 4296 | 0.3 | 0.3 | 0.00 | -2.8 | -2.8 | 0.00 | 0.00 |
| 448 | 0.0 | 4262 | 0.0 | 0.0 | 0.00 | -3.1 | -3.1 | 0.00 | 0.00 |
| 409 | 26.5 | 3550 | 227.9 | -6.2 | -0.08 | 324.6 | -33.4 | -0.46 | 0.98 |
| 379 | 26.5 | 3583 | 228.6 | -5.5 | -0.07 | 326.7 | -31.3 | -0.43 | 0.98 |
| 450 | 26.5 | 3597 | 223.4 | -10.7 | -0.15 | 337.8 | -20.2 | -0.28 | 0.98 |
| 410 | 26.5 | 4343 | 234.1 | -9.7 | -0.13 | 313.0 | -45.0 | -0.62 | 1.10 |
| 380 | 26.5 | 4321 | 236.7 | -7.1 | -0.10 | 318.4 | -39.6 | -0.54 | 1.10 |
| 451 | 26.5 | 4339 | 231.2 | -12.6 | -0.17 | 298.4 | -59.6 | -0.82 | 1.10 |
| 411* | 26.5 | 3507 | 69.8 | -178.6 | -2.44 | 134.0 | -224.0 | -3.07 | 1.16 |
| 381 | 26.5 | 5045 | 237.2 | -11.2 | -0.15 | 302.8 | -55.2 | -0.76 | 1.16 |
| 453 | 26.5 | 5085 | 232.9 | -15.5 | -0.21 | 317.4 | -40.6 | -0.56 | 1.16 |

*Run is no good

TABLE 7.3

Lift and Drag Characteristics
21/2.5 Inlet, 8 inch Transition

Hull Drag = 152.0 Hull Lift = 358.0

| Run | Vel | RPM | Drag | $D_i$ | $C_{Di}$ | Lift | $L_i$ | $C_{Li}$ | IVR |
|---|---|---|---|---|---|---|---|---|---|
| 416 | 0.0 | 2790 | 0.2 | 0.2 | 0.00 | -1.3 | -1.3 | 0.00 | 0.00 |
| 438 | 0.0 | 2816 | 0.3 | 0.3 | 0.00 | -2.3 | -2.3 | 0.00 | 0.00 |
| 455 | 0.0 | 2822 | 0.5 | 0.5 | 0.00 | -1.7 | -1.7 | 0.00 | 0.00 |
| 417 | 0.0 | 3550 | 0.5 | 0.5 | 0.00 | 0.1 | 0.1 | 0.00 | 0.00 |
| 439 | 0.0 | 3588 | 0.5 | 0.5 | 0.00 | -3.6 | -3.6 | 0.00 | 0.00 |
| 456 | 0.0 | 3560 | 0.0 | 0.0 | 0.00 | -2.9 | -2.9 | 0.00 | 0.00 |
| 418 | 0.0 | 4255 | 0.6 | 0.6 | 0.00 | -4.9 | -4.9 | 0.00 | 0.00 |
| 440 | 0.0 | 4296 | 0.4 | 0.4 | 0.00 | -3.0 | -3.0 | 0.00 | 0.00 |
| 457 | 0.0 | 4271 | 0.1 | 0.1 | 0.00 | -3.2 | -3.2 | 0.00 | 0.00 |
| 422 | 26.5 | 3568 | 230.4 | -3.2 | -0.04 | 311.7 | -46.3 | -0.63 | 0.98 |
| 442 | 26.5 | 3583 | 226.8 | -6.8 | -0.09 | 330.5 | -27.5 | -0.38 | 0.98 |
| 458 | 26.5 | 3658 | 225.5 | -8.1 | -0.11 | 315.0 | -43.0 | -0.59 | 0.98 |
| 423 | 26.5 | 4367 | 238.3 | -4.0 | -0.05 | 299.8 | -58.2 | -0.80 | 1.08 |
| 444 | 26.5 | 4331 | 235.5 | -6.8 | -0.09 | 315.1 | -42.9 | -0.59 | 1.08 |
| 459 | 26.5 | 4333 | 233.7 | -8.6 | -0.12 | 299.1 | -58.9 | -0.81 | 1.08 |
| 425 | 26.5 | 5106 | 242.0 | -4.9 | -0.07 | 292.3 | -65.7 | -0.90 | 1.14 |
| 445 | 26.5 | 5169 | 238.4 | -8.5 | -0.12 | 308.3 | -49.7 | -0.68 | 1.14 |
| 460* | 26.5 | 3987 | 85.9 | -161.0 | -2.20 | 97.6 | -260.4 | -3.56 | 1.14 |

*Run is no good

TABLE 7.4

Lift and Drag Characteristics
21/2.5 Inlet, 10 inch Transition

Hull Drag = 152.0   Hull Lift = 358.0

| Run | Vel | RPM | Drag | $D_i$ | $C_{Di}$ | Lift | $L_i$ | $C_{Li}$ | IVR |
|---|---|---|---|---|---|---|---|---|---|
| 402 | 0.0 | 2796 | 0.4 | 0.4 | 0.00 | -5.0 | -5.0 | 0.00 | 0.00 |
| 389 | 0.0 | 2876 | 0.2 | 0.2 | 0.00 | -1.3 | -1.3 | 0.00 | 0.00 |
| 465 | 0.0 | 2817 | 0.1 | 0.1 | 0.00 | -5.2 | -5.2 | 0.00 | 0.00 |
| 403 | 0.0 | 3528 | 0.5 | 0.5 | 0.00 | -3.0 | -3.0 | 0.00 | 0.00 |
| 390 | 0.0 | 3550 | 0.0 | 0.0 | 0.00 | -1.6 | -1.6 | 0.00 | 0.00 |
| 466 | 0.0 | 3560 | 0.2 | 0.2 | 0.00 | -5.8 | -5.8 | 0.00 | 0.00 |
| 404 | 0.0 | 4280 | 0.6 | 0.6 | 0.00 | -3.7 | -3.7 | 0.00 | 0.00 |
| 391 | 0.0 | 4312 | 1.4 | 1.4 | 0.00 | -3.9 | -3.9 | 0.00 | 0.00 |
| 467 | 0.0 | 4271 | -0.2 | -0.2 | 0.00 | -6.6 | -6.6 | 0.00 | 0.00 |
| 399 | 26.5 | 3567 | 226.5 | -7.1 | -0.10 | 304.4 | -53.6 | -0.73 | 0.98 |
| 394 | 26.5 | 3566 | 225.9 | -7.7 | -0.10 | 313.4 | -44.6 | -0.61 | 0.98 |
| 468 | 26.5 | 3579 | 225.8 | -7.8 | -0.11 | 311.5 | -46.5 | -0.64 | 0.98 |
| 400 | 26.5 | 4318 | 234.1 | -7.7 | -0.11 | 299.1 | -58.9 | -0.81 | 1.08 |
| 395 | 26.5 | 4354 | 240.5 | -1.3 | -0.02 | 300.0 | -58.0 | -0.79 | 1.08 |
| 470 | 26.5 | 4352 | 232.9 | -8.9 | -0.12 | 298.4 | -59.6 | -0.82 | 1.08 |
| 401 | 26.5 | 5102 | 240.5 | -7.9 | -0.11 | 299.6 | -58.4 | -0.80 | 1.16 |
| 397 | 26.5 | 5148 | 244.7 | -3.7 | -0.05 | 294.3 | -63.7 | -0.87 | 1.16 |
| 472 | 26.5 | 5033 | 237.2 | -11.2 | -0.15 | 317.2 | -40.8 | -0.56 | 1.16 |

TABLE 7.5

Lift and Drag Characteristics
27/0 Inlet, 6 inch Transition

Hull Drag = 135.0 Hull Lift = 349.0

| Run | Vel | RPM | Drag | $D_i$ | $C_{Di}$ | Lift | $L_i$ | $C_{Li}$ | IVR |
|---|---|---|---|---|---|---|---|---|---|
| 493 | 0.0 | 2799 | 0.4 | 0.4 | 0.00 | 0.1 | 0.1 | 0.00 | 0.00 |
| 501 | 0.0 | 2816 | 0.4 | 0.4 | 0.00 | 1.4 | 1.4 | 0.00 | 0.00 |
| 476 | 0.0 | 2810 | 0.5 | 0.5 | 0.00 | -1.0 | -1.0 | 0.00 | 0.00 |
| 495 | 0.0 | 3542 | 0.3 | 0.3 | 0.00 | -2.9 | -2.9 | 0.00 | 0.00 |
| 502 | 0.0 | 3579 | 0.6 | 0.6 | 0.00 | -0.1 | -0.1 | 0.00 | 0.00 |
| 477 | 0.0 | 3552 | 0.7 | 0.7 | 0.00 | -2.7 | -2.7 | 0.00 | 0.00 |
| 496 | 0.0 | 4296 | 0.4 | 0.4 | 0.00 | -4.0 | -4.0 | 0.00 | 0.00 |
| 503 | 0.0 | 4291 | 0.7 | 0.7 | 0.00 | -1.3 | -1.3 | 0.00 | 0.00 |
| 478 | 0.0 | 4288 | 0.6 | 0.6 | 0.00 | -5.1 | -5.1 | 0.00 | 0.00 |
| 497 | 26.5 | 3574 | 218.3 | 1.2 | 0.01 | 305.2 | -43.8 | -0.47 | 0.96 |
| 504 | 26.5 | 3596 | 217.9 | 0.8 | 0.01 | 303.5 | -45.5 | -0.48 | 0.96 |
| 480 | 26.5 | 3528 | 217.2 | 0.1 | 0.00 | 298.8 | -50.2 | -0.53 | 0.96 |
| 498 | 26.5 | 4340 | 224.2 | -1.6 | -0.02 | 292.9 | -56.1 | -0.60 | 1.06 |
| 505 | 26.5 | 4384 | 223.2 | -2.6 | -0.03 | 299.8 | -49.2 | -0.52 | 1.06 |
| 481 | 26.5 | 4373 | 225.0 | -0.8 | -0.01 | 298.0 | -51.0 | -0.54 | 1.06 |
| 499 | 26.5 | 5099 | 230.3 | -1.7 | -0.02 | 300.5 | -48.5 | -0.52 | 1.13 |
| 506 | 26.5 | 5132 | 228.3 | -3.7 | -0.04 | 302.8 | -46.2 | -0.49 | 1.13 |
| 485 | 26.5 | 5103 | 231.7 | -0.3 | 0.00 | 242.2 | -106.8 | -1.14 | 1.13 |

TABLE 7.6

Lift and Drag Characteristics
27/0 Inlet, 10 inch Transition

Hull Drag = 135.0 Hull Lift = 349.0

| Run | Vel | RPM | Drag | $D_i$ | $C_{Di}$ | Lift | $L_i$ | $C_{Li}$ | IVR |
|---|---|---|---|---|---|---|---|---|---|
| 513 | 0.0 | 2827 | 0.2 | 0.2 | 0.00 | -0.8 | -0.8 | 0.00 | 0.00 |
| 507 | 0.0 | 2849 | 0.3 | 0.3 | 0.00 | -0.6 | -0.6 | 0.00 | 0.00 |
| 487 | 0.0 | 2799 | 0.0 | 0.0 | 0.00 | -1.1 | -1.1 | 0.00 | 0.00 |
| 514 | 0.0 | 3594 | 0.5 | 0.5 | 0.00 | -6.3 | -6.3 | 0.00 | 0.00 |
| 508 | 0.0 | 3587 | 0.3 | 0.3 | 0.00 | -2.8 | -2.8 | 0.00 | 0.00 |
| 488 | 0.0 | 3578 | 0.3 | 0.3 | 0.00 | -4.0 | -4.0 | 0.00 | 0.00 |
| 515 | 0.0 | 4299 | 0.5 | 0.5 | 0.00 | -4.7 | -4.7 | 0.00 | 0.00 |
| 509 | 0.0 | 4280 | 0.3 | 0.3 | 0.00 | -4.5 | -4.5 | 0.00 | 0.00 |
| 489 | 0.0 | 4298 | 0.5 | 0.5 | 0.00 | 1.1 | 1.1 | 0.00 | 0.00 |
| 516 | 26.5 | 3539 | 217.5 | 0.9 | 0.01 | 306.3 | -42.7 | -0.45 | 0.95 |
| 510 | 26.5 | 3560 | 217.1 | 0.5 | 0.01 | 306.7 | -42.3 | -0.45 | 0.95 |
| 490 | 26.5 | 3541 | 211.3 | -5.3 | -0.06 | 298.5 | -50.5 | -0.54 | 0.95 |
| 517 | 26.5 | 4305 | 225.4 | -0.9 | -0.01 | 300.4 | -48.6 | -0.52 | 1.06 |
| 511 | 26.5 | 4333 | 224.4 | -1.9 | -0.02 | 301.9 | -47.1 | -0.50 | 1.06 |
| 491 | 26.5 | 4348 | 220.9 | -5.4 | -0.06 | 290.2 | -58.8 | -0.63 | 1.06 |
| 518 | 26.5 | 5108 | 228.8 | -4.7 | -0.05 | 300.5 | -48.4 | -0.51 | 1.15 |
| 512 | 26.5 | 5107 | 227.5 | -6.0 | -0.06 | 287.8 | -61.2 | -0.65 | 1.15 |
| 492 | 26.5 | 5095 | 222.0 | -11.5 | -0.12 | 300.8 | -48.2 | -0.51 | 1.15 |

## TABLE 7.7

Lift and Drag Characteristics
21/0 Inlet, 6 inch Transition

Hull Drag = 135.0   Hull Lift = 349.0

| Run | Vel | RPM | Drag | $D_i$ | $C_{Di}$ | Lift | $L_i$ | $C_{Li}$ | IVR |
|---|---|---|---|---|---|---|---|---|---|
| 519 | 0.0 | 2851 | 0.3 | 0.3 | 0.00 | -2.5 | -2.5 | 0.00 | 0.00 |
| 537 | 0.0 | 2791 | -0.1 | -0.1 | 0.00 | 0.3 | 0.3 | 0.00 | 0.00 |
| 547 | 0.0 | 2820 | 0.2 | 0.2 | 0.00 | -1.6 | -1.6 | 0.00 | 0.00 |
| 520 | 0.0 | 3565 | 0.4 | 0.4 | 0.00 | -4.0 | -4.0 | 0.00 | 0.00 |
| 538 | 0.0 | 3533 | 0.2 | 0.2 | 0.00 | -1.3 | -1.3 | 0.00 | 0.00 |
| 548 | 0.0 | 3554 | 0.1 | 0.1 | 0.00 | -2.9 | -2.9 | 0.00 | 0.00 |
| 521 | 0.0 | 4269 | 0.1 | 0.1 | 0.00 | -4.0 | -4.0 | 0.00 | 0.00 |
| 539 | 0.0 | 4256 | 0.2 | 0.2 | 0.00 | -3.1 | -3.1 | 0.00 | 0.00 |
| 549 | 0.0 | 4266 | 0.2 | 0.2 | 0.00 | -2.4 | -2.4 | 0.00 | 0.00 |
| 522 | 26.5 | 3568 | 214.3 | 0.8 | 0.01 | 312.5 | -36.5 | -0.50 | 1.03 |
| 540 | 26.5 | 3559 | 212.7 | -0.8 | -0.01 | 313.2 | -35.8 | -0.49 | 1.03 |
| 550 | 26.5 | 3573 | 210.8 | -2.7 | -0.04 | 301.3 | -47.7 | -0.65 | 1.03 |
| 523 | 26.5 | 4382 | 224.1 | 2.4 | 0.03 | 303.9 | -45.1 | -0.62 | 1.14 |
| 541 | 26.5 | 4376 | 222.2 | 0.5 | 0.01 | 300.1 | -48.9 | -0.67 | 1.14 |
| 551 | 26.5 | 4342 | 218.3 | -3.4 | -0.05 | 296.0 | -53.0 | -0.73 | 1.14 |
| 524 | 26.5 | 5105 | 227.0 | -0.3 | 0.00 | 310.6 | -38.4 | -0.53 | 1.21 |
| 542 | 26.5 | 5119 | 226.0 | -1.3 | -0.02 | 283.8 | -65.2 | -0.89 | 1.21 |
| 554 | 26.5 | 4932 | 217.7 | -9.6 | -0.13 | 275.1 | -73.9 | -1.01 | 1.21 |

TABLE 7.8

Lift and Drag Characteristics
21/0 Inlet, 10 inch Transition

Hull Drag = 135.0   Hull Lift = 349.0

| Run | Vel | RPM | Drag | $D_i$ | $C_{Di}$ | Lift | $L_i$ | $C_{Li}$ | IVR |
|---|---|---|---|---|---|---|---|---|---|
| 525 | 0.0 | 2811 | 0.4 | 0.4 | 0.00 | -1.5 | -1.5 | 0.00 | 0.00 |
| 531 | 0.0 | 2820 | 0.2 | 0.2 | 0.00 | -0.2 | -0.2 | 0.00 | 0.00 |
| 555 | 0.0 | 2802 | 0.0 | 0.0 | 0.00 | -3.3 | -3.3 | 0.00 | 0.00 |
| 526 | 0.0 | 3558 | 0.5 | 0.5 | 0.00 | -2.8 | -2.8 | 0.00 | 0.00 |
| 532 | 0.0 | 3582 | 0.2 | 0.2 | 0.00 | -1.0 | -1.0 | 0.00 | 0.00 |
| 556 | 0.0 | 3550 | -0.2 | -0.2 | 0.00 | -1.6 | -1.6 | 0.00 | 0.00 |
| 527 | 0.0 | 4270 | 0.3 | 0.3 | 0.00 | -2.3 | -2.3 | 0.00 | 0.00 |
| 533 | 0.0 | 4201 | 0.1 | 0.1 | 0.00 | -3.0 | -3.0 | 0.00 | 0.00 |
| 557 | 0.0 | 4242 | 0.1 | 0.1 | 0.00 | -2.4 | -2.4 | 0.00 | 0.00 |
| 528 | 26.5 | 3582 | 213.6 | 0.1 | 0.00 | 308.0 | -41.0 | -0.56 | 1.03 |
| 534 | 26.5 | 3539 | 212.2 | -1.3 | -0.02 | 301.8 | -47.2 | -0.65 | 1.03 |
| 560 | 26.5 | 3545 | 211.4 | -2.1 | -0.03 | 300.3 | -48.7 | -0.67 | 1.03 |
| 529 | 26.5 | 4352 | 221.9 | -1.8 | -0.03 | 302.6 | -46.4 | -0.64 | 1.17 |
| 535 | 26.5 | 4313 | 221.9 | -1.8 | -0.03 | 304.6 | -44.4 | -0.61 | 1.17 |
| 561 | 26.5 | 4382 | 220.7 | -3.0 | -0.04 | 288.4 | -60.6 | -0.83 | 1.17 |
| 530 | 26.5 | 5106 | 229.1 | 2.3 | 0.03 | 292.4 | -56.6 | -0.77 | 1.21 |
| 536 | 26.5 | 5114 | 223.2 | -3.6 | -0.05 | 288.4 | -60.6 | -0.83 | 1.21 |
| 562 | 26.5 | 5060 | 225.9 | -0.9 | -0.01 | 290.7 | -58.3 | -0.80 | 1.21 |

TABLE 8

Loss Coefficient, for all Inlets

| Model Velocity fps | Nominal Impeller rpm | Stevens | 21/2.50 | | | 27/0 | | 21/0 | |
|---|---|---|---|---|---|---|---|---|---|
| | | 8 | 6 | 8 | 10 | 6 | 10 | 6 | 10 |
| 0 | 2180 | 0.119# | | | | | | | |
| 0 | 2800 | 0.119# | 0.425# | 0.260 | 0.193 | 0.146 | 0.116 | 0.235 | 0.230 |
| 0 | 3600 | 0.166# | 0.403# | 0.270 | 0.239 | 0.170 | 0.124 | 0.235 | 0.271 |
| 0 | 4300 | | 0.425# | 0.253 | 0.208 | 0.170 | 0.174 | 0.273 | 0.287 |
| 26.5 | 3600 | 0.247 | 0.304 | 0.323 | 0.312 | 0.255 | 0.275 | 0.397 | 0.400 |
| 26.5 | 4300 | 0.188 | 0.266 | 0.304 | 0.294 | 0.247 | 0.244 | 0.328 | 0.347 |
| 26.5 | 5100 | 0.186 | 0.270+ | 0.304+ | 0.296 | 0.262 | 0.230 | 0.387 | 0.413 |

TABLE 9

Ram Pressure Recovery for all Inlet

| Model Velocity fps | Nominal Impeller rpm | Stevens | 21/2.50 | | | 27/0 | | 21/0 | |
|---|---|---|---|---|---|---|---|---|---|
| | | 8 | 6 | 8 | 10 | 6 | 10 | 6 | 10 |
| 26.5 | 3600 | 0.613 | 0.520 | 0.491 | 0.514 | 0.595 | 0.570 | 0.420 | 0.420 |
| 26.5 | 4300 | 0.625 | 0.470 | 0.414 | 0.438 | 0.517 | 0.522 | 0.419 | 0.359 |
| 26.5 | 5100 | 0.574 | 0.407+ | 0.358+ | 0.350 | 0.415 | 0.470 | 0.222 | 0.178 |

TABLE 10

Cavitation Index for all Inlets

| Model Velocity fps | Nominal Impeler rpm | Stevens | 21/2.50 | | | 27/0 | | 21/0 | |
|---|---|---|---|---|---|---|---|---|---|
| | | 8 | 6 | 8 | 10 | 6 | 10 | 6 | 10 |
| 26.5 | 3600 | 1.218 | 1.127 | 1.115 | 1.148 | 1.165 | 1.189 | 1.220 | 1.240 |
| 26.5 | 4300 | 0.757 | 0.657 | 0.676 | 0.699 | 0.713 | 0.704 | 0.733 | 0.707 |
| 26.5 | 5100 | 0.488 | 0.474+ | 0.439+ | 0.436 | 0.444 | 0.424 | 0.491 | 0.477 |

#No bollard fairing attached at the inlet
+Estimated value

TABLE 11

Boundary Layer Profile

| Run No | Velocity fps | Inlet Velocity Ratio | Depth in | Boundary Layer Velocity, % free steam |
|---|---|---|---|---|
| 566 | 26.5 | 0 | 0.06 | .843 |
| 565 | 26.5 | 0 | 0.10 | .913 |
| 567 | 26.5 | 0 | 0.20 | .957 |
| 564 | 26.5 | 0 | 0.30 | 1.000 |
| 563 | 26.5 | 0 | 0.50 | 1.000 |
| 571 | 26.5 | 1.16 | 0.10 | .930 |
| 568 | 26.5 | 1.16 | 0.20 | 1.022 |
| 569 | 26.5 | 1.16 | 0.30 | 1.057 |
| 570 | 26.5 | 1.16 | 0.50 | 1.035 |

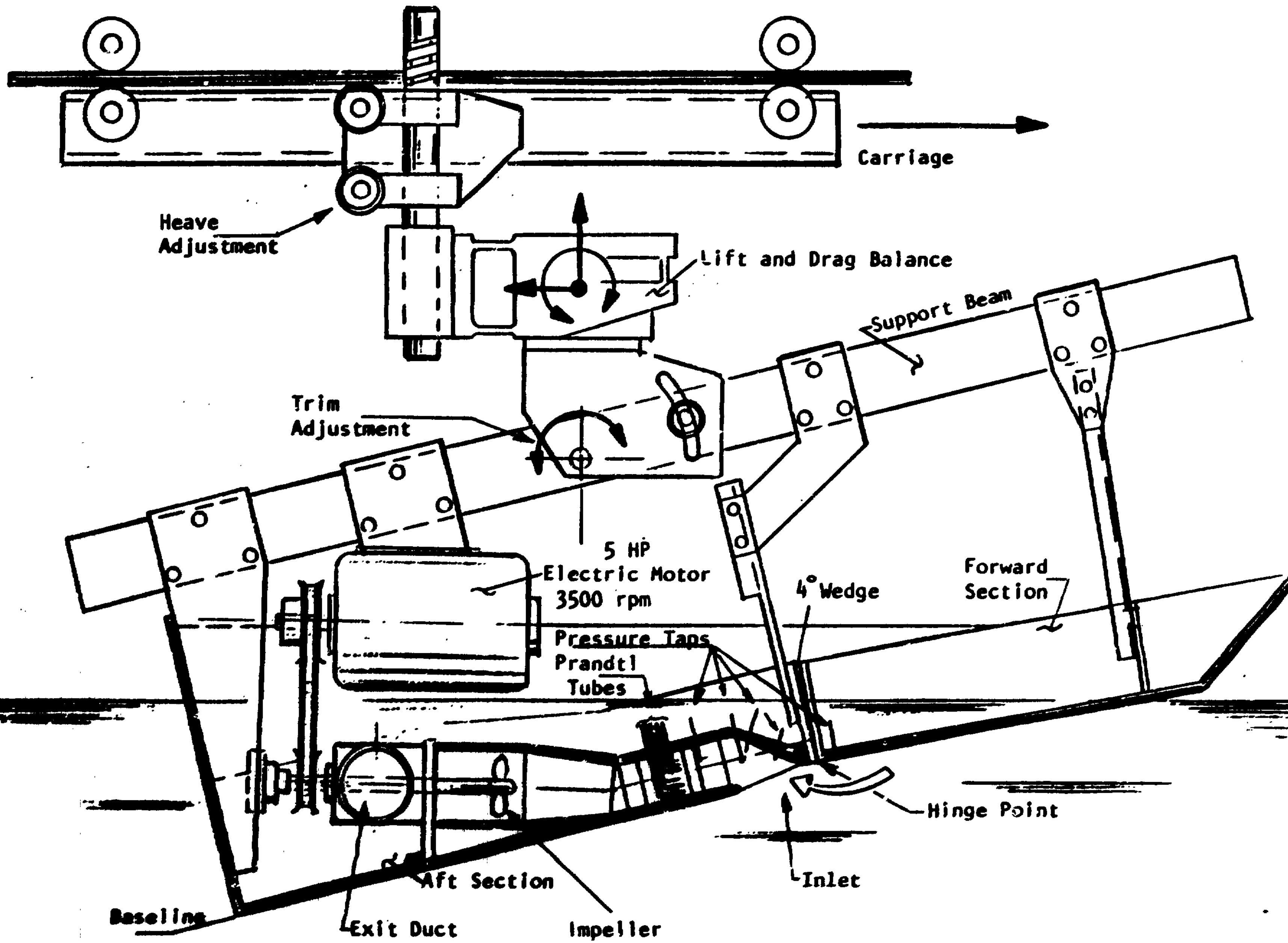



FIGURE 1 SKETCH OF MODEL AND TEST APPARATUS

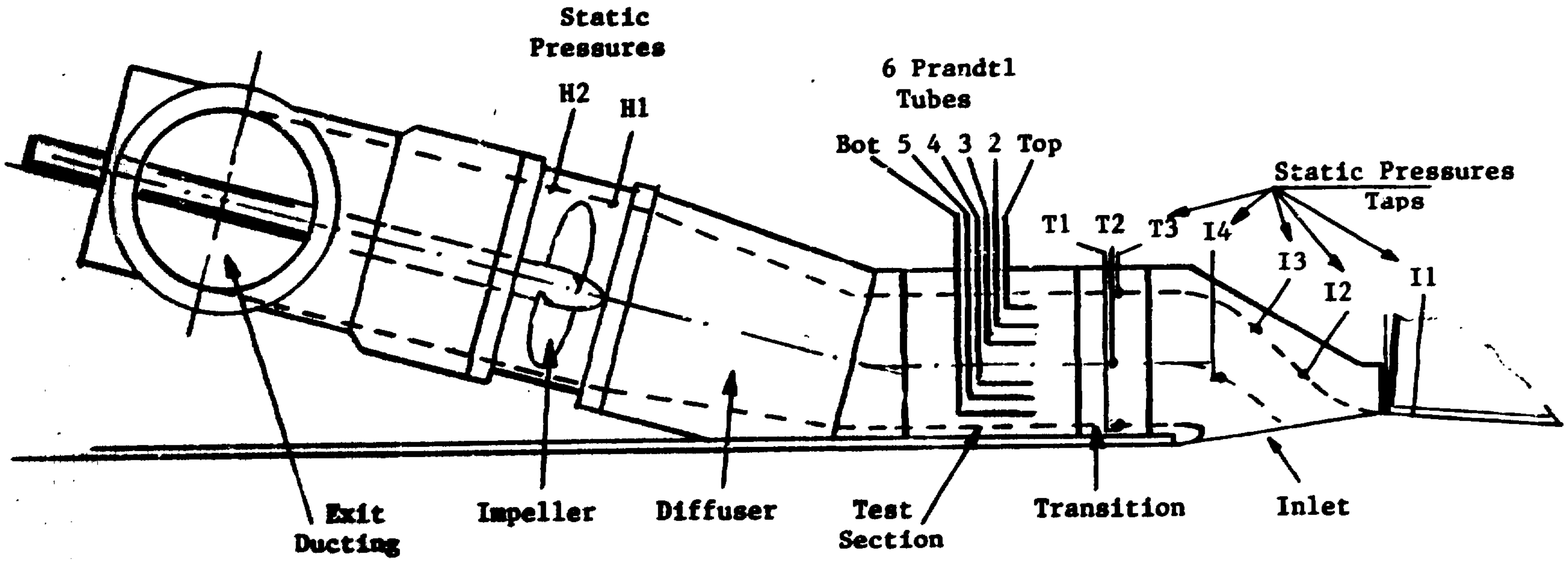



FIGURE 2 SCHEMATIC OF WATERJET DUCTING AND PRESSURE TAPS

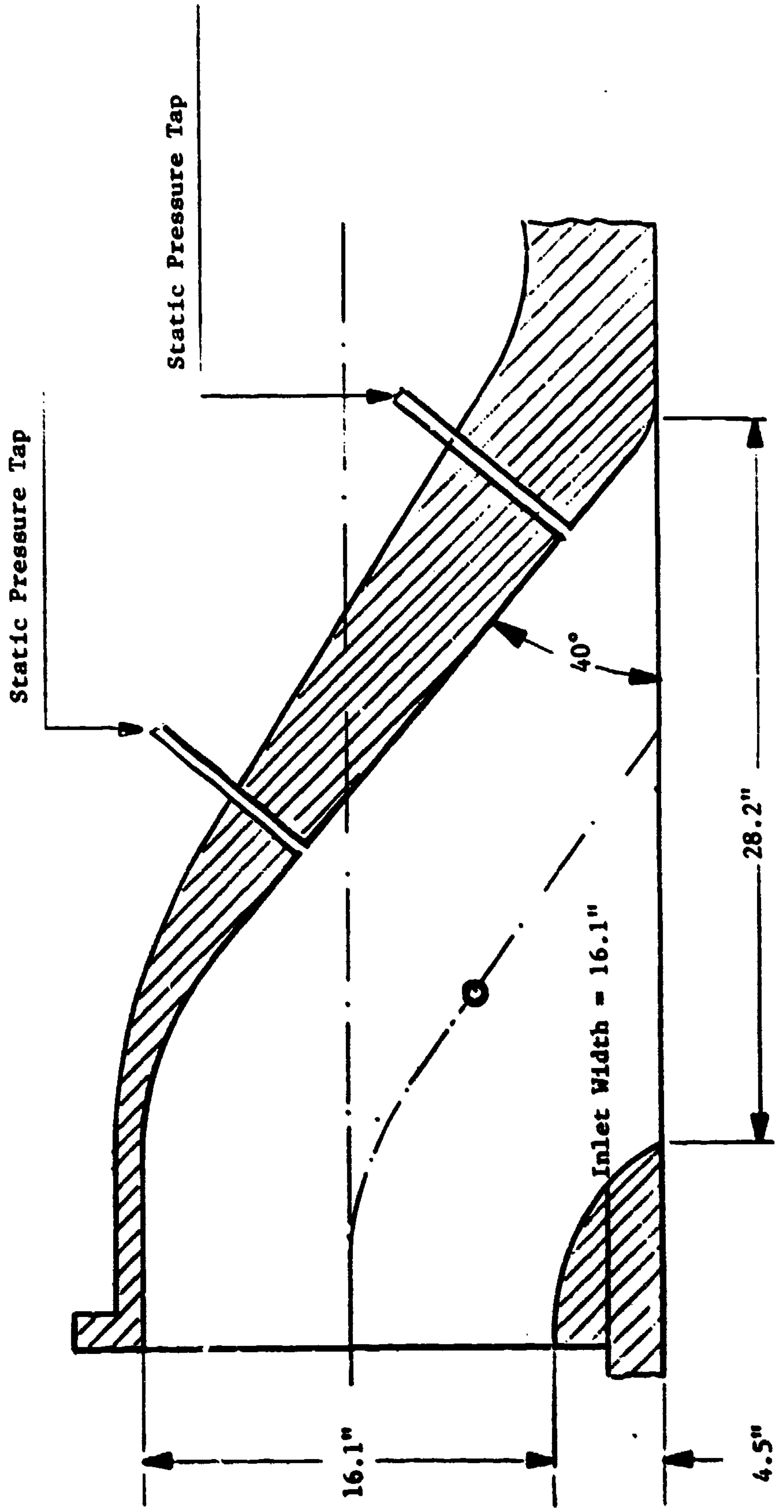



FIGURE 3 STEVENS INLET

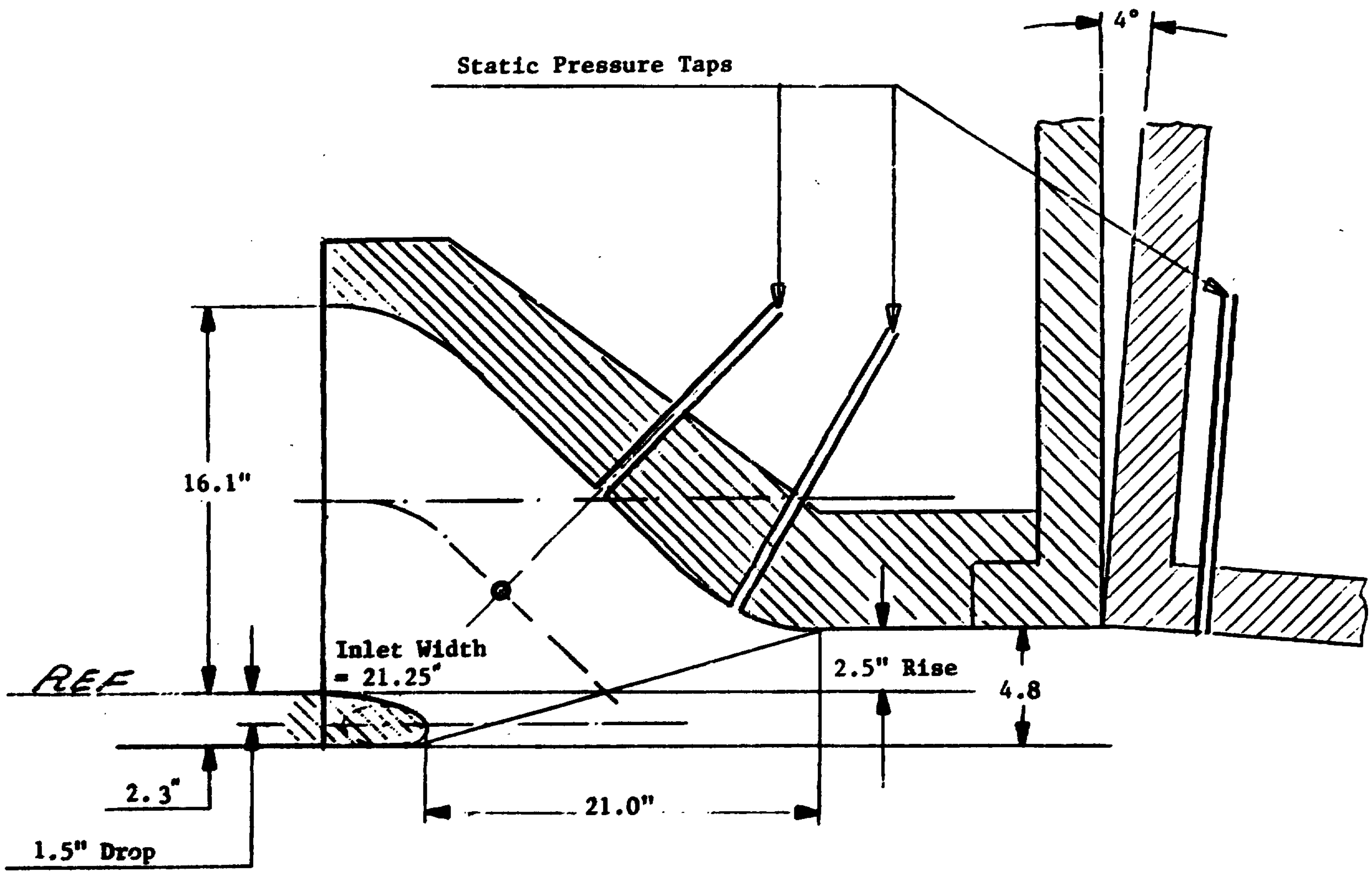



FIGURE 4 21/2.50 INLET

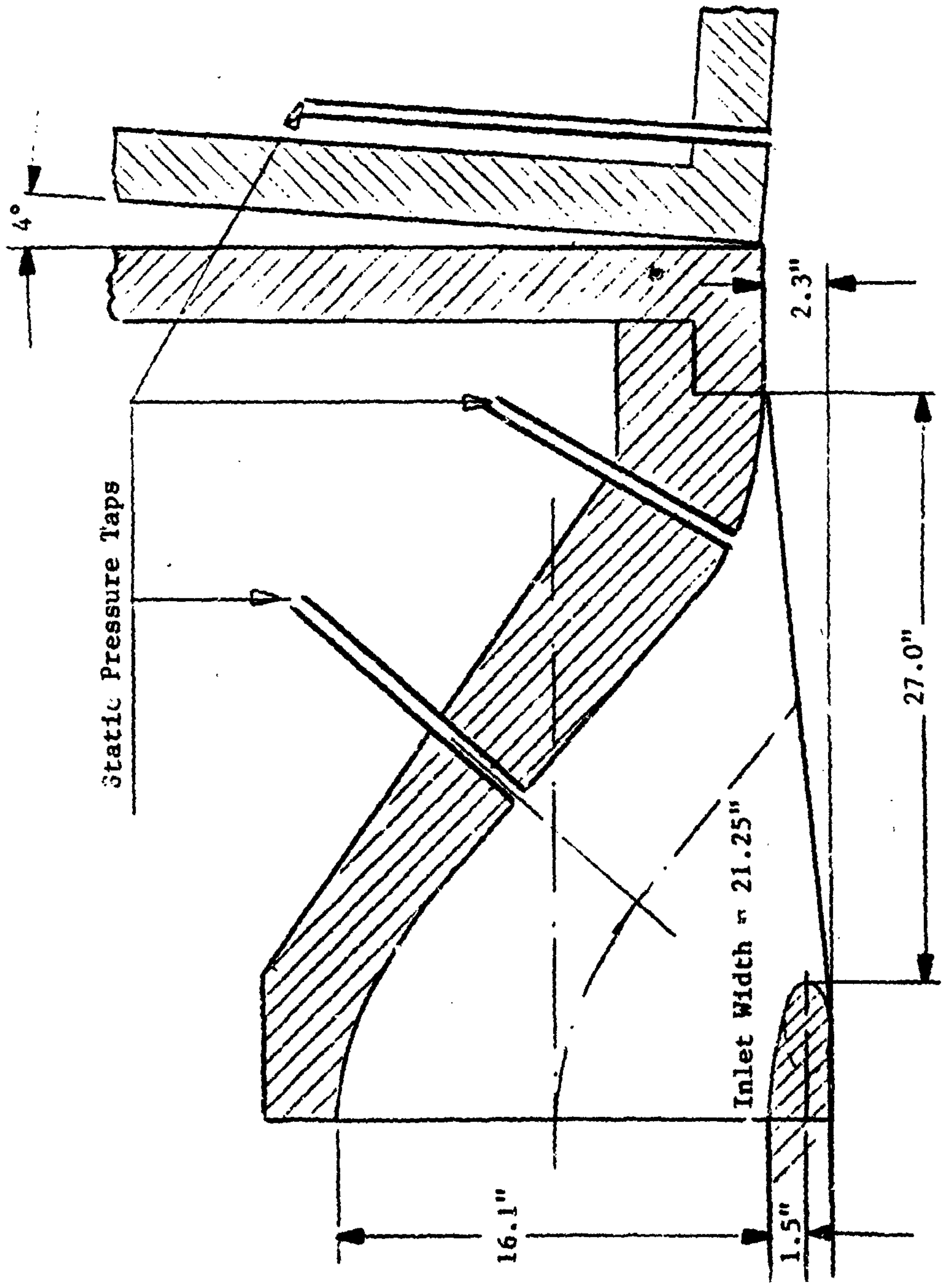



FIGURE 5 27/0 INLET

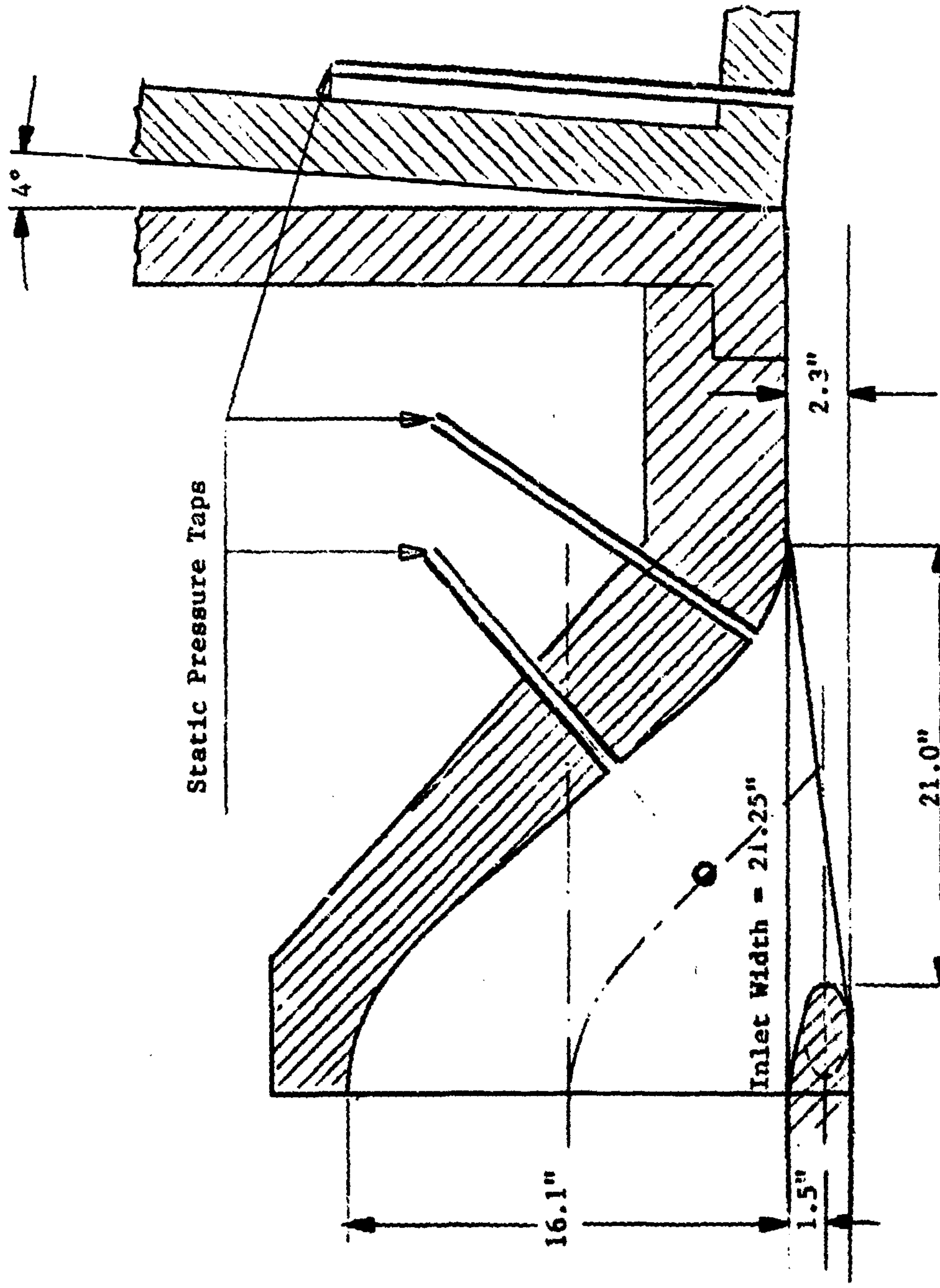



FIGURE 6 21/0 INLET

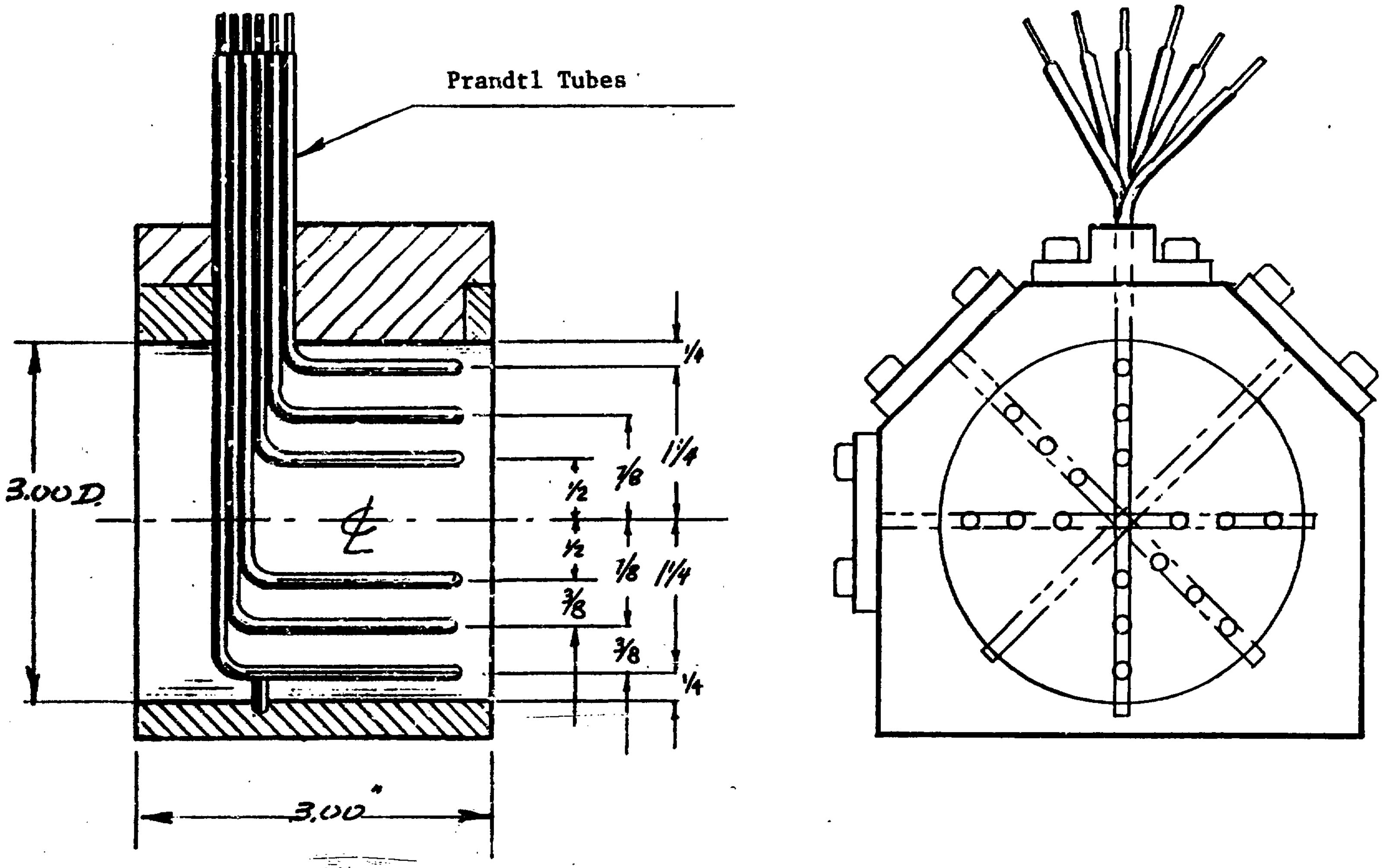



FIGURE 7 TEST SECTION AND LOCATION OF PRANDTL TUBES

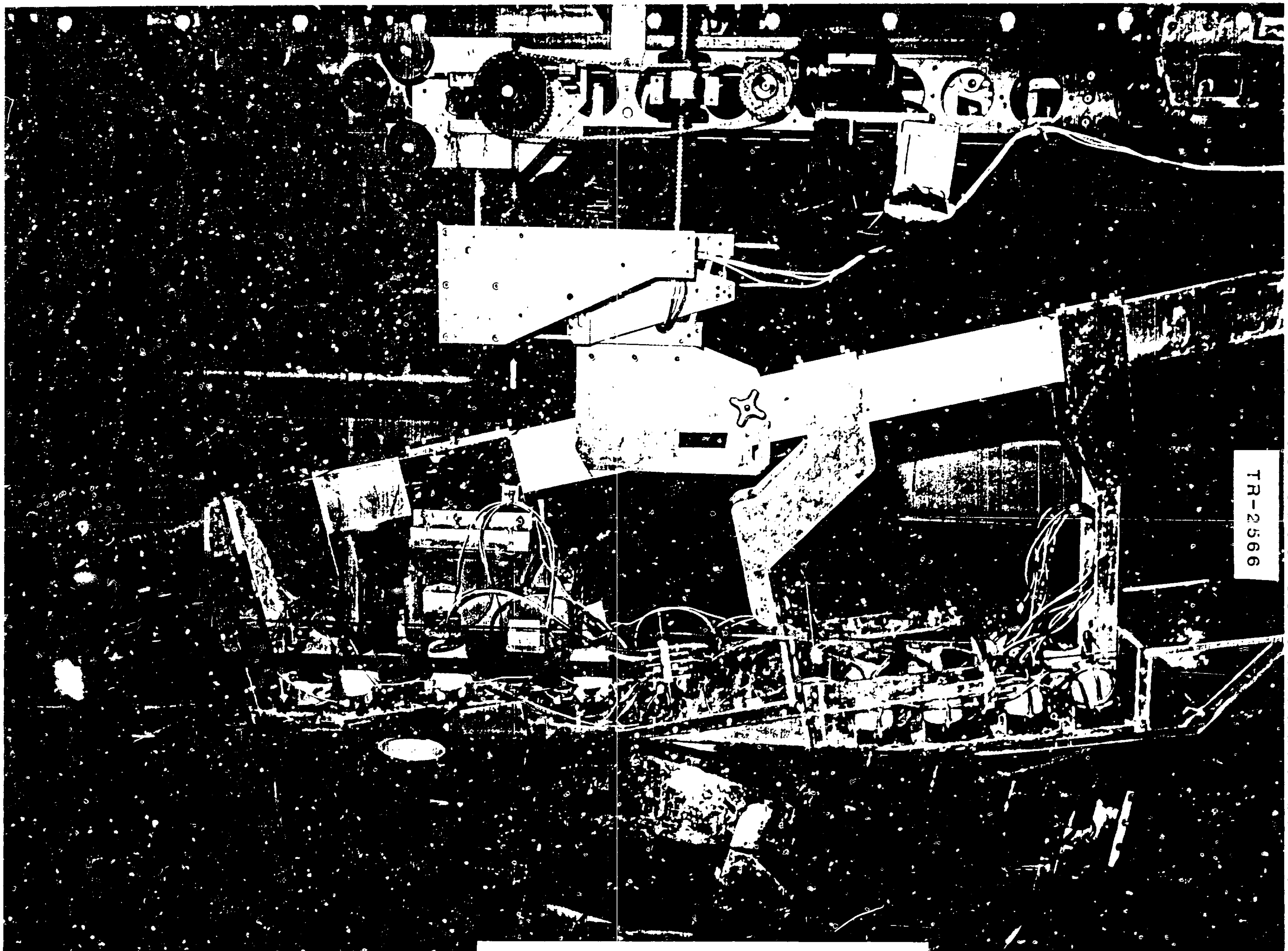
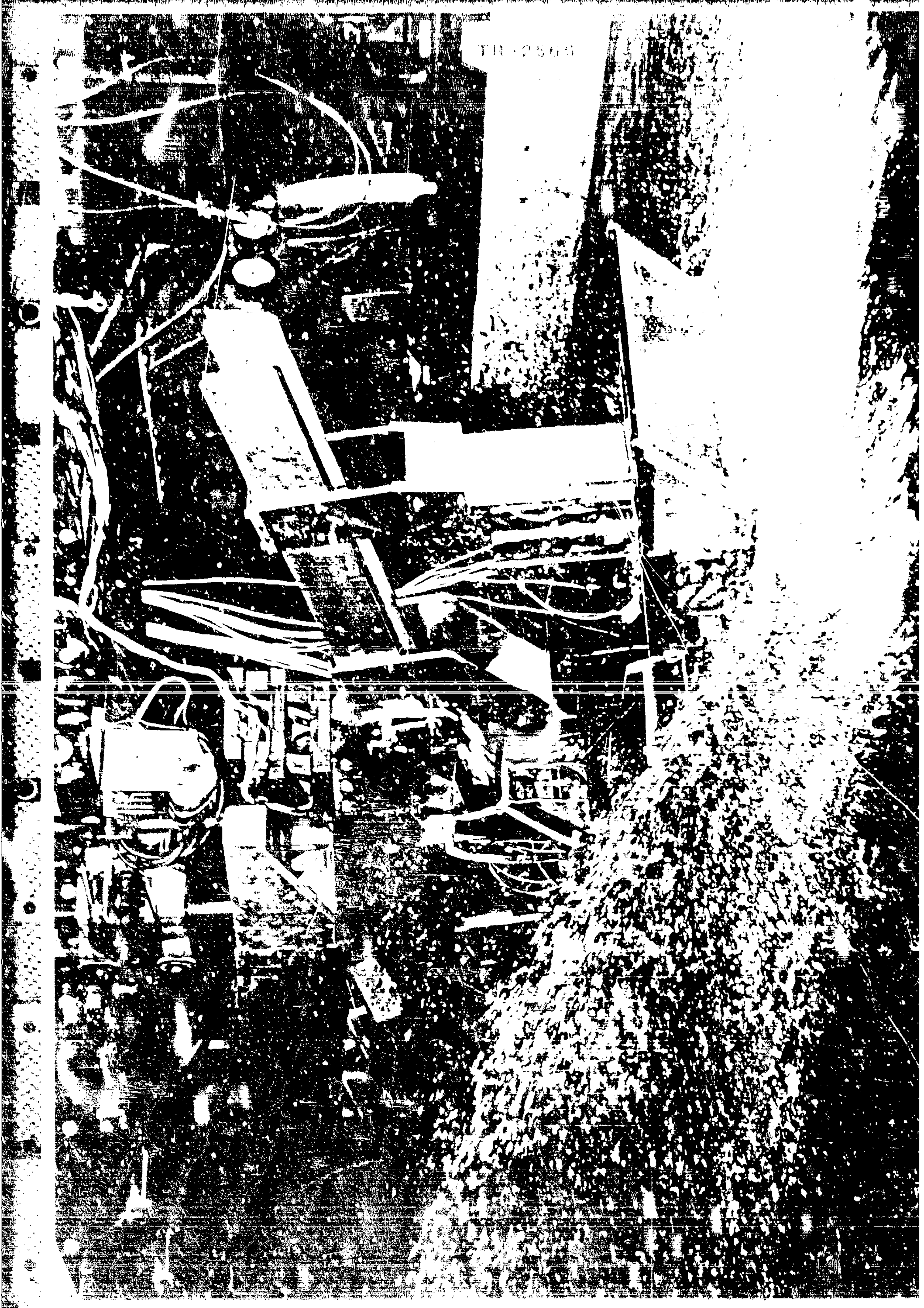


FIGURE 8 WATERJET TESTCRAFT



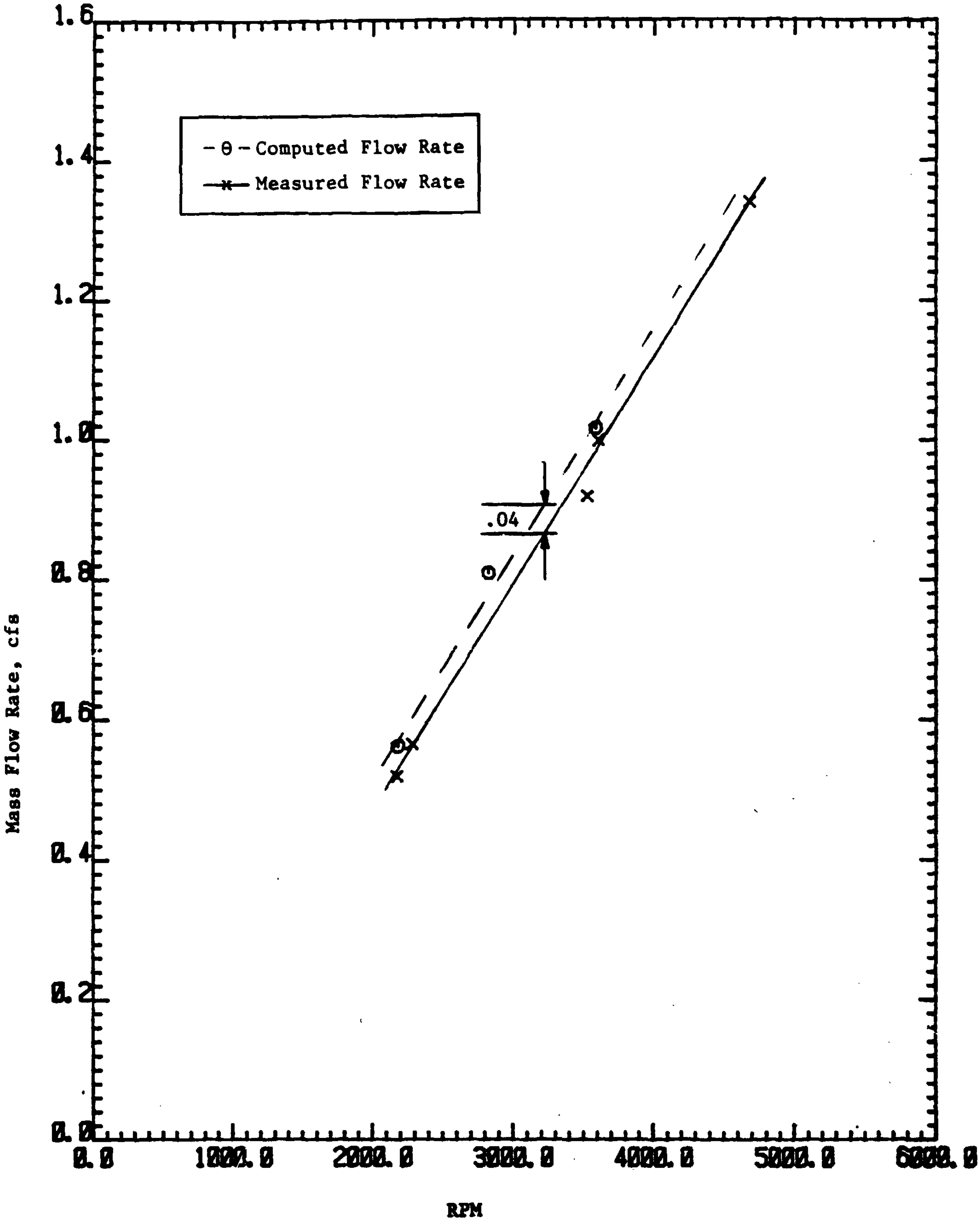



FIGURE 10 CALIBRATION OF FLOW RATE

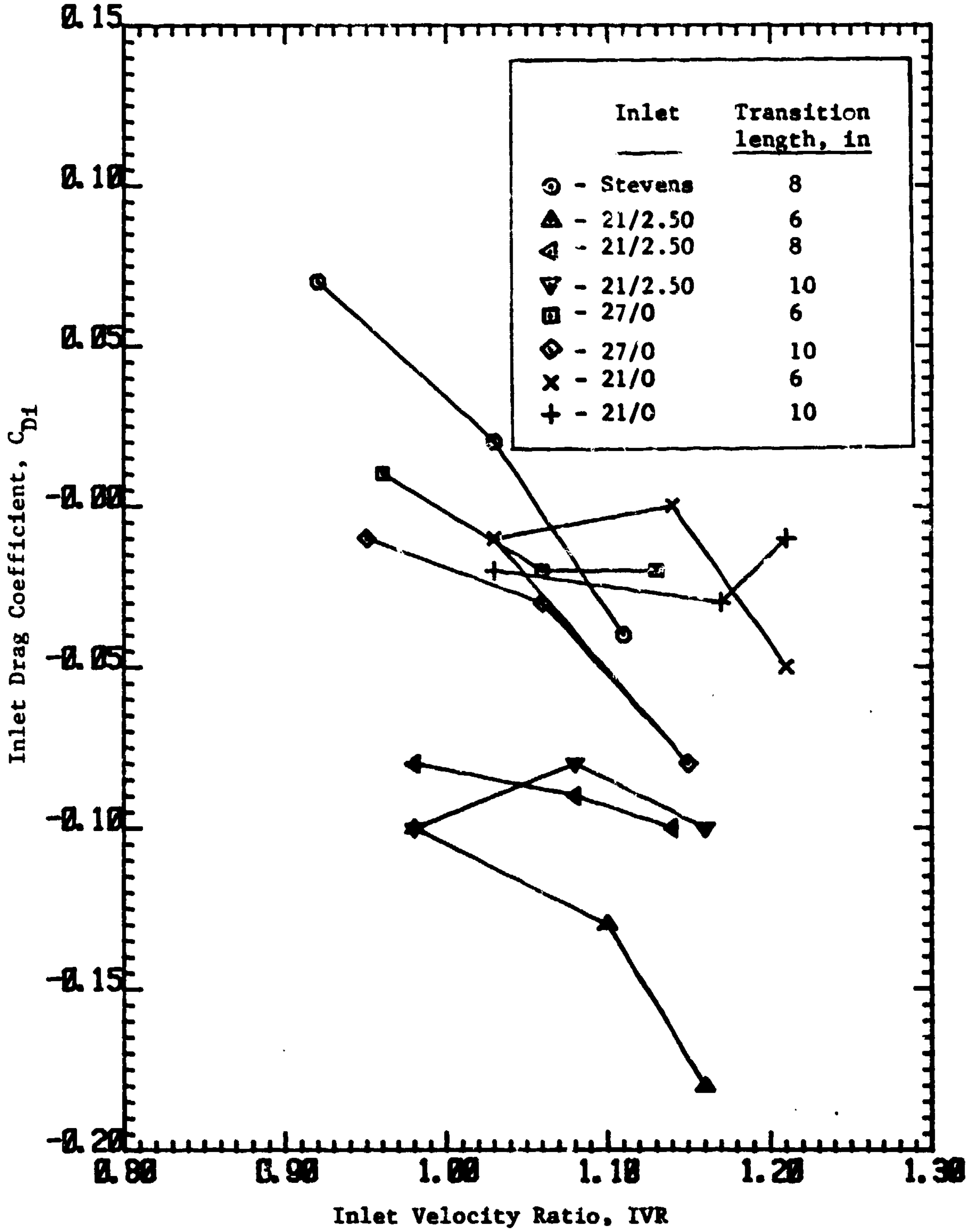



FIGURE 11 INLET DRAG COEFFICIENT VS IVR

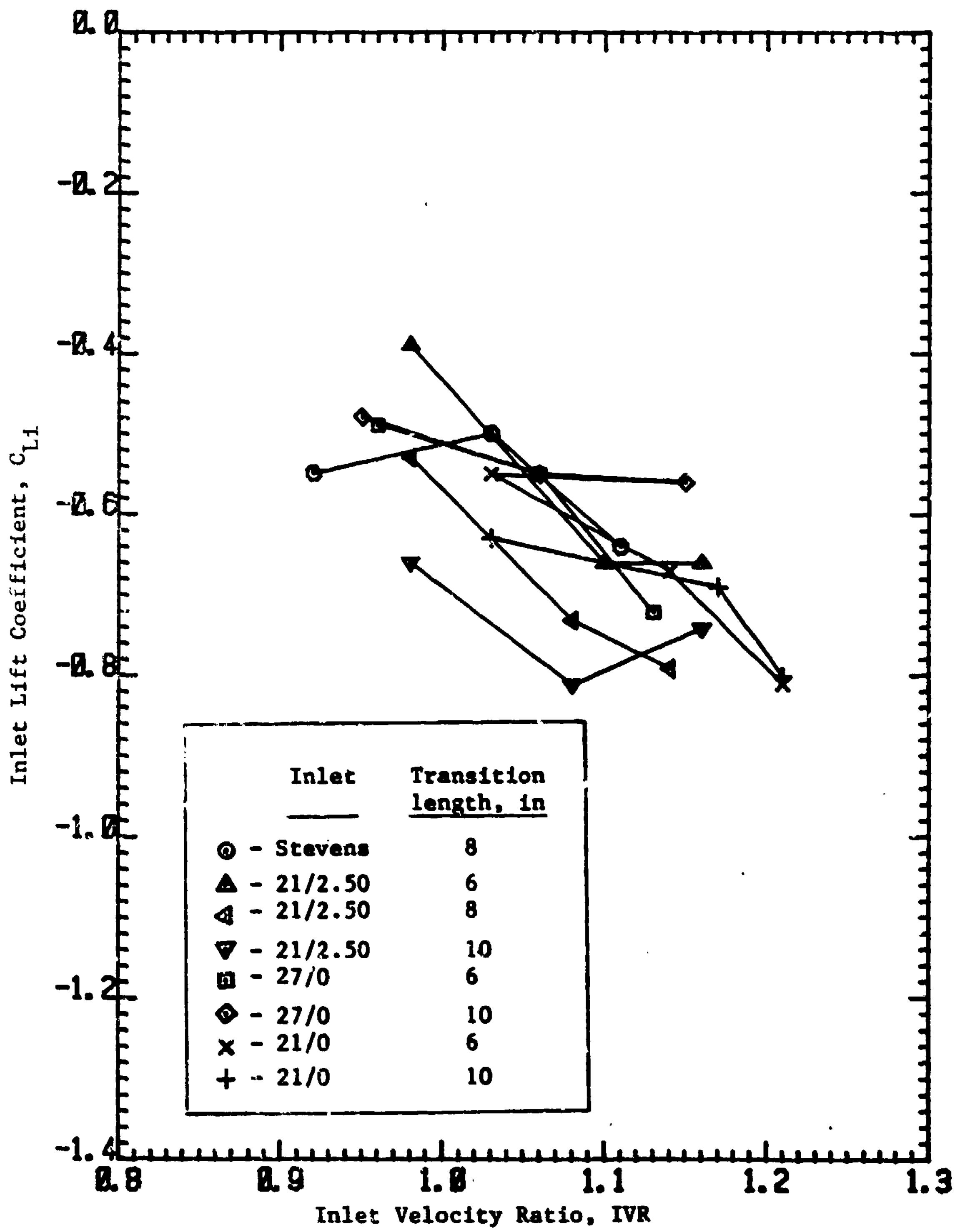



FIGURE 12 INLET LIFT COEFFICIENT VS IVR

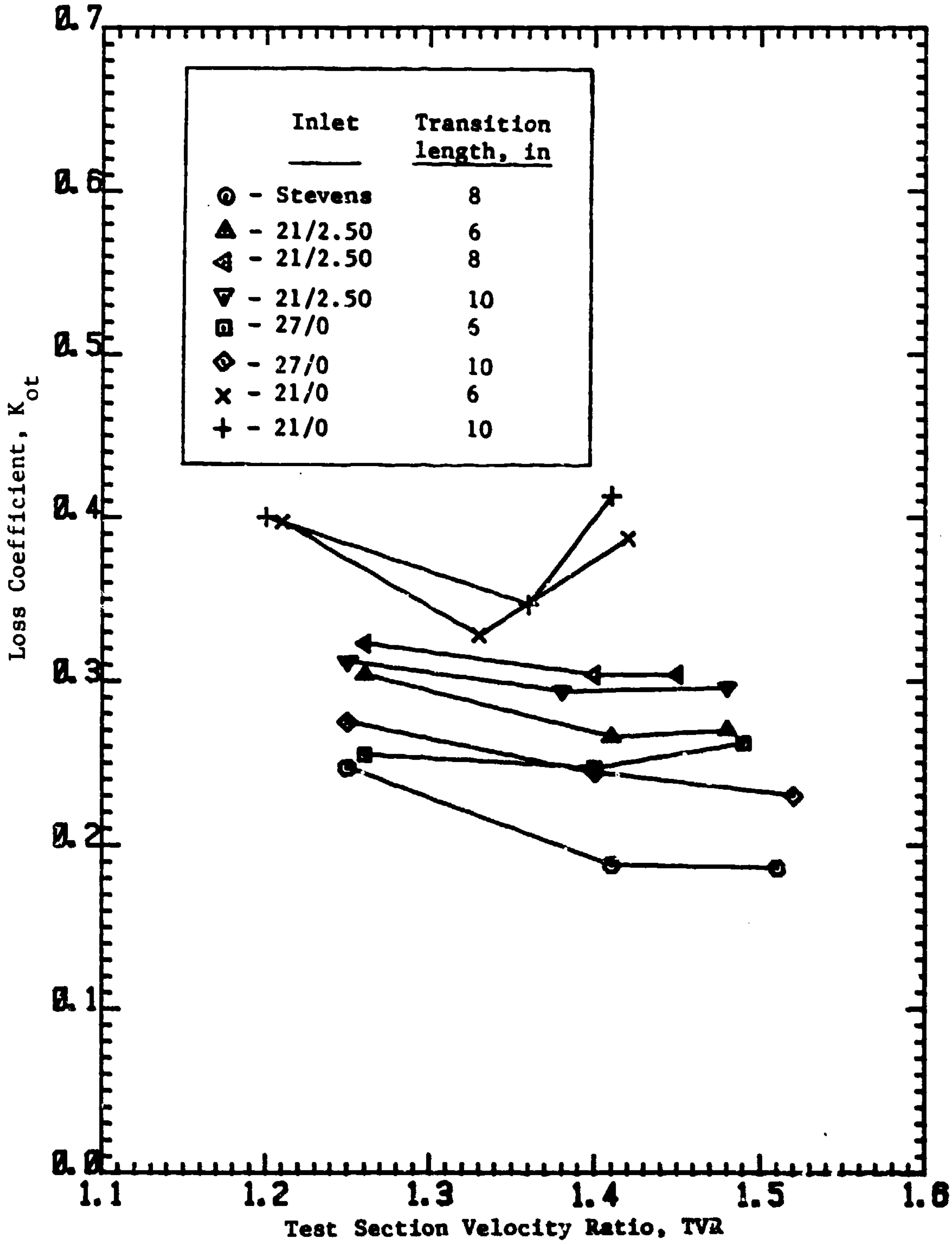



FIGURE 13 LOSS COEFFICIENT VS TVR

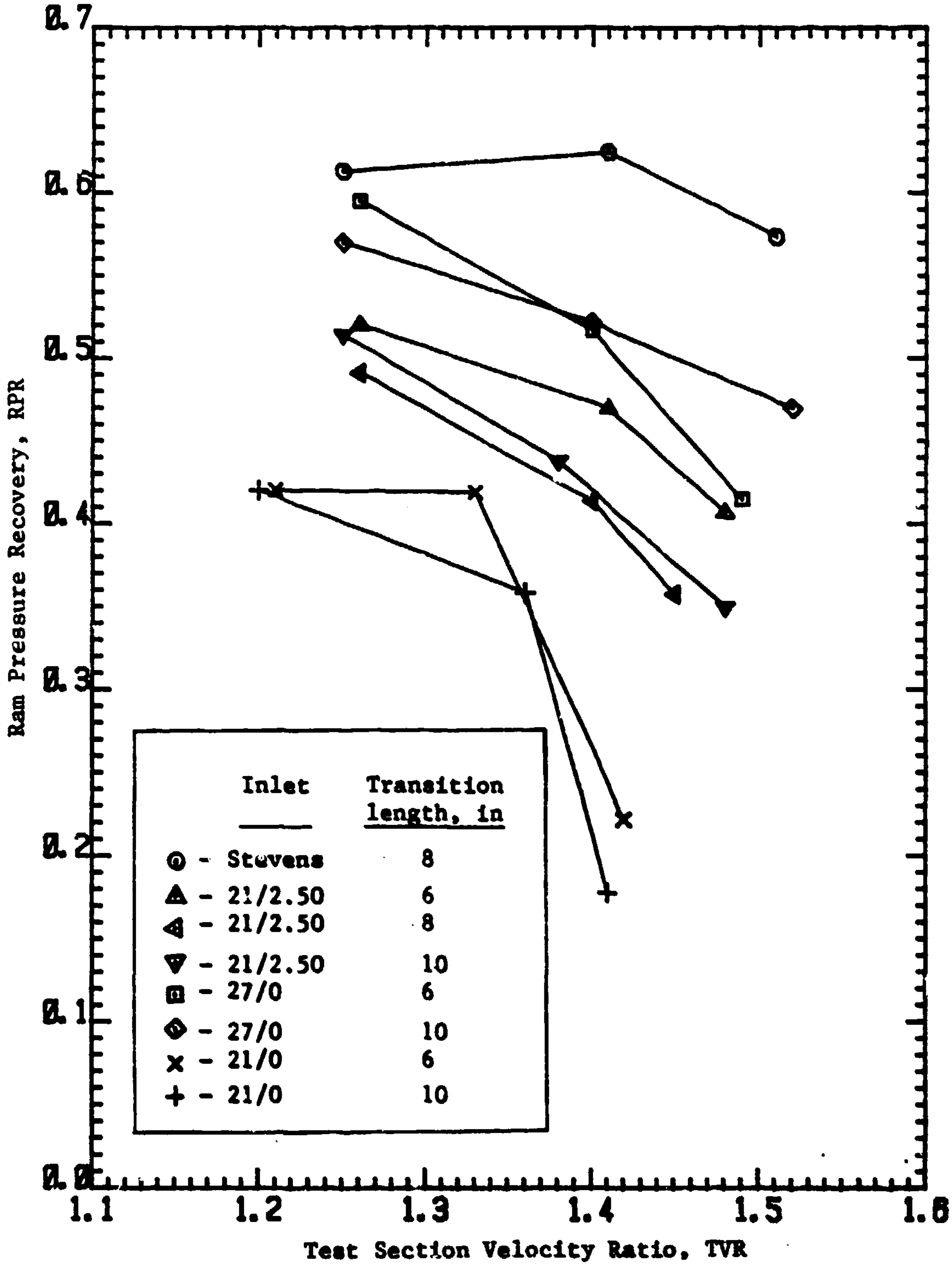



FIGURE 14 RAM PRESSURE RECOVERY, VS TVR

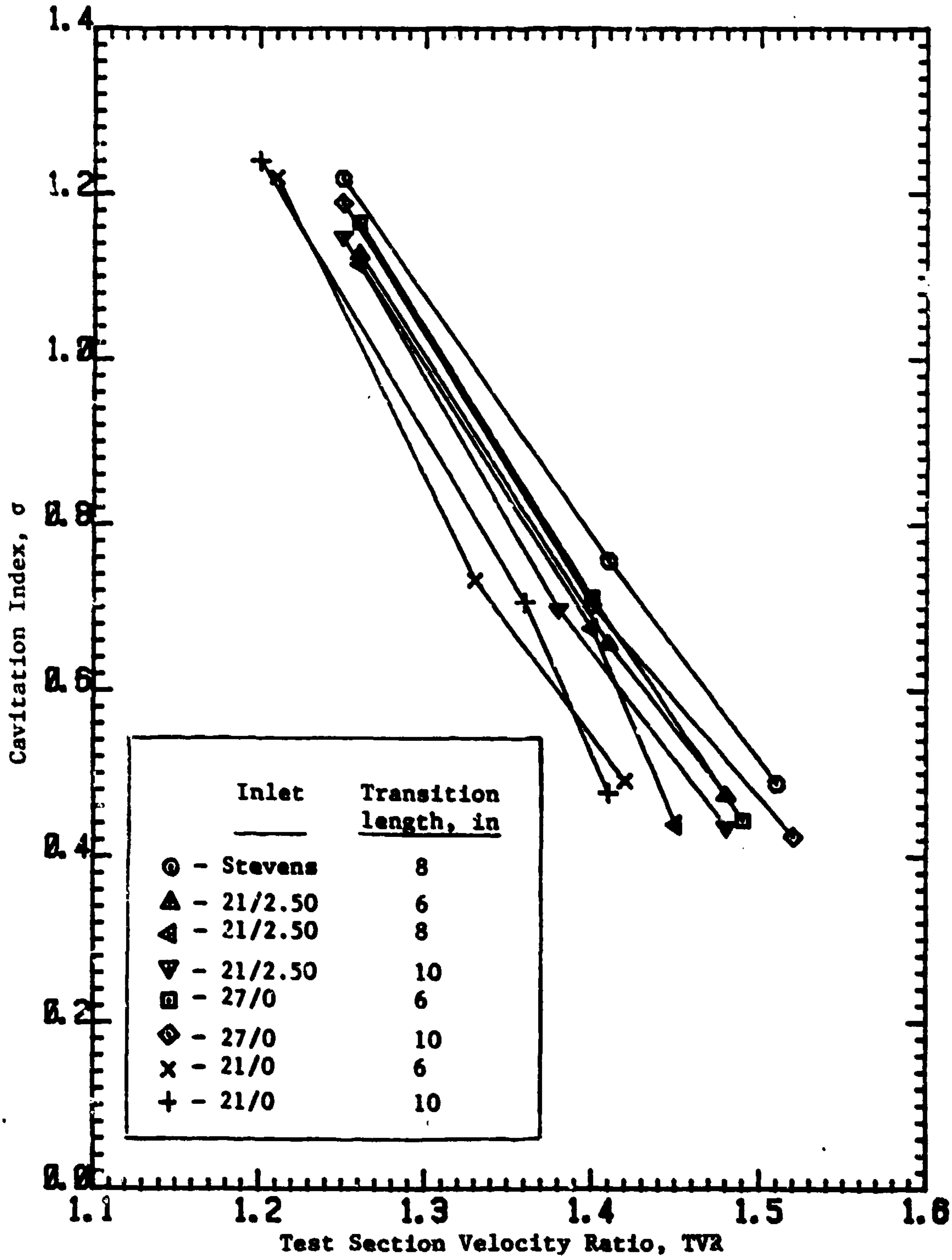



FIGURE 15 CAVITATION INDEX VS TVR

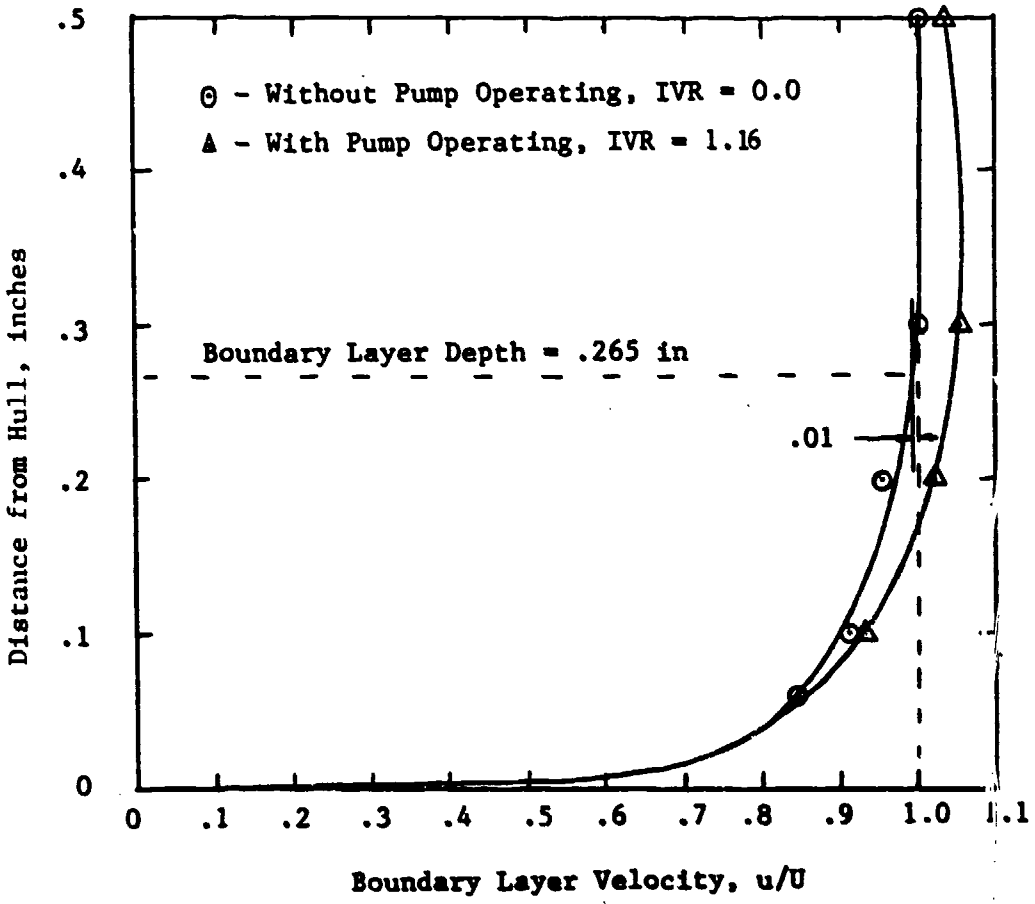



FIGURE 16 VELOCITY PROFILE WITH AND WITHOUT PUMP OPERATING

## APPENDIX A

### Jet Velocity Calibration

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 334 | 0.0 | 2184. | 0. | Static | -1.1 | -1.1 | -1.1 | -1.3 | -0.8 | -0.6 | -1.05 | |
| | | | | Dynamic | 1.1 | 1.1 | 1.2 | 0.9 | 0.8 | 0.3 | 0.83 | 0.52 |
| | | | | Total | 0.0 | 0.0 | 0.1 | -0.4 | 0.0 | -0.3 | -0.22 | |
| 365 | 0.0 | 2190. | 45. | Static | -1.1 | -1.1 | -1.2 | -0.9 | -1.0 | -1.1 | -1.16 | |
| | | | | Dynamic | 1.1 | 1.2 | 1.1 | 0.5 | 0.5 | 0.8 | 0.90 | 0.54 |
| | | | | Total | 0.0 | 0.1 | -0.1 | -0.4 | -0.5 | -0.3 | -0.26 | |
| 330 | 0.0 | 2182. | 90. | Static | -1.1 | -1.1 | -1.1 | -1.2 | -1.1 | -0.9 | -1.14 | |
| | | | | Dynamic | 1.2 | 1.2 | 1.1 | 1.1 | 1.6 | 1.3 | 1.26 | 0.65 |
| | | | | Total | 0.1 | 0.1 | 0.0 | -0.1 | 0.5 | 0.4 | 0.12 | |

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 335 | 0.0 | 2803. | 0. | Static | -2.1 | -2.1 | -2.2 | -2.2 | -2.0 | -1.8 | -2.10 | |
| | | | | Dynamic | 2.1 | 2.1 | 2.3 | 1.3 | 2.4 | 1.5 | 1.93 | 0.81 |
| | | | | Total | 0.0 | 0.0 | 0.1 | -0.9 | 0.4 | -0.3 | -0.17 | |
| 366 | 0.0 | 2836. | 45. | Static | -2.1 | -2.1 | -2.2 | -1.9 | -1.9 | -2.1 | -2.16 | |
| | | | | Dynamic | 2.2 | 2.2 | 2.2 | 0.9 | 0.8 | 1.5 | 1.68 | 0.75 |
| | | | | Total | 0.1 | 0.1 | 0.0 | -1.0 | -1.1 | -0.6 | -0.48 | |
| 331 | 0.0 | 2834. | 90. | Static | -2.1 | -2.1 | -2.3 | -2.3 | -2.2 | -2.1 | -2.23 | |
| | | | | Dynamic | 2.2 | 2.2 | 2.1 | 2.0 | 3.5 | 3.0 | 2.56 | 0.93 |
| | | | | Total | 0.1 | 0.1 | -0.2 | -0.3 | 1.3 | 0.9 | 0.33 | |

| Run | Vel | RPM | Deg | Location | Top | 2nd | 3rd | 4th | 5th | Bottom | Average | Q-tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 336 | 0.0 | 3533. | 0. | Static | -3.6 | -3.5 | -3.7 | -3.7 | -3.1 | -2.8 | -3.40 | |
| | | | | Dynamic | 3.6 | 3.5 | 3.9 | 1.8 | 3.3 | 1.8 | 2.94 | 0.99 |
| | | | | Total | 0.0 | 0.0 | 0.2 | -1.9 | 0.2 | -1.0 | -0.46 | |
| 367 | 0.0 | 3603. | 45. | Static | -3.7 | -3.7 | -3.9 | -3.4 | -3.2 | -3.6 | -3.66 | |
| | | | | Dynamic | 3.8 | 3.9 | 3.8 | 1.3 | 1.1 | 2.4 | 2.83 | 0.96 |
| | | | | Total | 0.1 | 0.2 | -0.1 | -2.1 | -2.1 | -1.2 | -0.83 | |
| 332 | 0.0 | 3609. | 90. | Static | -3.7 | -3.7 | -3.9 | -4.0 | -3.5 | -3.0 | -3.61 | |
| | | | | Dynamic | 3.8 | 3.7 | 3.6 | 3.2 | 4.8 | 4.1 | 3.95 | 1.16 |
| | | | | Total | 0.1 | 0.0 | -0.3 | -0.8 | 1.3 | 1.1 | 0.34 | |

# APPENDIX A
(Concluded)

## Jet Velocity Calibration

| Impeller rpm | Mass Flow Rate cfs | |
|---|---|---|
| 2186 | 0.563 | Integrated flow rate |
| 2827 | 0.810 | Integrated flow rate |
| 3587 | 1.018 | Integrated flow rate |
| 2283 | 0.567 | Measured flow rate |
| 3607 | 1.000 | Measured flow rate |
| 4687 | 1.340 | Measured flow rate |
| 2182 | 0.520 | Measured flow rate |
| 3524 | 0.920 | Measured flow rate |

# DISTRIBUTION LIST

5 Copies: David W. Taylor Naval Ship
Research and Development Center
Department of the Navy
Bethesda, MD 20084

Attention: Mr. W. Zeitfuss Jr.
Code 1240

1 Copy: David W. Taylor Naval Ship
Research and Development Center
Department of the Navy
Bethesda, MD 20084

Attention: Mr. S. Stricker
Code 2721

1 Copy: David W. Taylor Naval Ship
Research and Development Center
Department of the Navy
Bethesda, MD 20084

Attention: (LIBRARY)

1 Copy: Defense Technical Information Center
Cameron Station
Alexandria, VA 22314

1 Copy: Office of Naval Research
715 Broadway (Fifth Floor)
New York, New York 10003

1 Copy: Office of Naval Research
800 N. Quincy Street
Arlington, VA 22217

Attention: Dr. E. Rood
Code 1132